AQUACULTURE

British Columbia's Future

An Industry Assessment

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Aquaculture: British Columbia's Future

A joint project by the
B.C. Salmon Farmers Association
the
B.C. Shellfish Growers Association
and the
B.C. Trout Farmers Association

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Foreword

A relatively new industry in British Columbia, aquaculture has a long history in other parts of the world. The farming of aquatic species began centuries ago in the Far East and has since spread to every continent except Antarctica. The development of all forms of aquaculture has been driven by the desire to increase supplies of fish, shellfish, and marine plant food products and to decrease market and consumer dependence on fluctuating and seasonal wild harvests. Today, aquaculture is viewed globally as the most practical means by which to achieve increased, sustainable supplies of fish and shellfish food products.

British Columbia's aquaculture industry has evolved rapidly in recent years and is now at an important stage in its development. Advances in technology and husbandry skills, breakthroughs in disease management, market place fluctuations, and environmental interactions are but a few of the factors affecting the course of aquaculture business activity.

Aquaculture in B.C. has enjoyed the support of government during the growth years in the latter half of the 1980s. It is imperative that this support continue, with special emphasis on pragmatically addressing the wide variety of issues discussed in this document—issues that include:

- production economics
- market development
- environmental concerns
- seedstock acquisition
- applied research and development

Through cooperative action and shared goals, producers and government can ensure the sustainable economic success of B.C.'s aquaculture enterprises. Fish and shellfish farmers want to increase their already substantial contributions to local communities and further strengthen the provincial economy.

Aquaculture: British Columbia's Future is intended to provide B.C.'s aquaculture industry with a means of communicating:

- its current status
- the key opportunities and constraints facing each industry sector in the early 1990s
- specific development objectives and priorities.

To create this document, an innovative process was used. Drawing on private sector expertise, the Ministry of Agriculture, Fisheries and Food hosted industry assessment and commodity planning sessions, recording and synthesizing the input of participants. Industry members and producer associations ensured that the diverse nature of aquaculture in the Province was fully represented at these sessions and exercised editorial control to ensure the resulting document clearly reflects industry's points of view.

The dynamics of this rapidly changing industry must be clearly recognized and carefully considered in all future decision making. What is certain however, is that well-managed aquaculture is both environmentally and socio-economically appropriate—able to make an important contribution to British Columbia's future.

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Thanks are also extended to Mr. R. (Bob) Haywood, of Peagler, Haywood & Associates, Vancouver B.C., who served as facilitator during the various industry planning sessions. Participants at these events very much appreciate his successful efforts to ensure the facilitated sessions accurately identified the concerns and aspirations of each sector.

In addition, thanks go to GT Publishing Services Ltd. of Vancouver B.C., which provided editorial and design assistance in preparing this document for publication.

Finally, special thanks to all those aquaculturists who voluntarily took time away from their farm businesses to participate in the creation of this document. Their contributions and insights were invaluable, and clearly attest to their vision of aquaculture's sustainable future in British Columbia.

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Executive Summary

British Columbia's aquaculture industry first started around 1912 with the importation of Pacific oysters from Japan. The Province now supports the commercial culture of ten various aquatic species—both in marine and freshwater environments—which are estimated to have generated sales worth over $110 million in 1991.

Over the last five years salmon farming has experienced significant growth, with other commodity sectors achieving steady increases in production. Future growth of salmon, oyster, and trout farming is expected to be moderate and steady.

Highlights by Commodity

Salmon

- The first marine farms were established in the early 1970s. Rapid growth and development were experienced in the mid 1980s. Currently, 55 licensed companies control 125 salmon producing farms. An additional 68 farm sites are tenured awaiting licensing and development.
- Salmon farming is the largest economic component of aquaculture industry with total sales of over $90 million in 1990. This is 35% of the B.C. commercial fishery's five-year average landed value of $259 million during 1985-1989.
- Salmon aquaculture generates over 1 200 direct full-time jobs for residents of B.C.'s coastal communities.
- Cultured salmon ranked fourth in farm gate value among all agricultural commodities in B.C. in 1990.
- Depressed world prices over the last two years and the costs associated with learning to culture Pacific salmon precipitated a major financial restructuring and corporate consolidation of the sector.
- Chinook and Atlantic salmon are the two primary species grown on B.C. farms. In 1991, chinook comprised 75% of the industry's production. By 1993 Atlantic salmon will make up at least 50% of B.C.'s total farm production.

- The market for cultured salmon is concentrated in fresh sales to export markets, primarily in the U.S.

Oysters:

- Currently, 282 companies hold 401 oyster culture tenures over nearly 1 523 hectares of Crown aquatic lands. Direct employment is estimated at 400 jobs.
- There have been recent production increases, with total sales estimated at $3.2 million in 1990.
- Good prospects exist for increased production, especially as most sites are not fully developed.
- Domestic and export market expansion opportunities are very good.

Trout:

- British Columbia's first freshwater trout farms were established in 1956.
- Trout farms are typically small, family-run ventures that have developed as ancillary operations to existing agricultural farms.
- In 1990, 54 of 99 farms reported food market and/or fee-fishing sales totaling nearly $600,000.
- B.C. farmed trout faces strong competition from U.S. imports.

Other species:

- The culture of several new species, both marine and freshwater, is under way in B.C., with most in the very early stages of development.
- Other species provide opportunities for production diversification for both shellfish and finfish farms.
- The next three years will see significant gains made in the commercial culture of Manila clams, scallops, and Arctic char.
- Some growth opportunities will also exist for production of mussels and marine plants.
- The farming of most of these new species requires further economic analysis.

Key Opportunities and Constraints

Environmental Issues

Opportunities:

- B.C. has an abundance of good site locations and some of the best culture conditions in the world.
- The quality of B.C.'s aquatic resources and how well the aquaculture industry adapts to and complements the environment are key to long-term success.

Constraints:

- Pollution from external sources (e.g., pulp mills, oil spills, sewage, etc.), endemic diseases, and algae blooms are some of the major concerns facing aquaculturists.
- Conflicts with other resource users pose potential problems.

- There is relatively limited physical access to freshwater resources that meet quality specifications for finfish hatcheries and inland fish farms.
- Possible interactions between wild and cultured stocks are not fully understood.

Processing and Marketing Issues

Opportunities:

- Strict product inspection regulations enhance the wholesome image of B.C. seafood.
- North American consumption of high-protein seafood products is growing.
- Significant domestic and export marketing opportunities appear to exist, especially for shellfish and value-added seafood products.
- B.C. is now the leading supplier of farmed salmon to the United States.
- The B.C. industry is well positioned for further penetration of the U.S. market and, secondarily, Pacific Rim markets.

Constraints:

- The industry is driven by production considerations rather than by marketing considerations.
- Distributors/wholesalers and retailers are largely in control of prices.
- Due to commodity pricing, the industry is vulnerable to cyclical market demand and supply fluctuations.
- B.C. seafood products are largely undifferentiated from those of competitors.
- There is a lack of production and marketing coordination among farmers.
- Differences in national inspection and testing standards for fish diseases and seafood product safety can restrict access to U.S. and other markets.

Farm Viability Issues

Opportunities:

- Increased efficiency can be achieved with industry consolidation, vertical integration, and adoption of improved management systems and techniques.
- Improved husbandry and application of technology—particularly in areas of disease mitigation, feed strategies, inventory control, and shellfish harvesting—can enhance production.
- Production inputs such as good quality farm sites, domesticated broodstock, and a skilled labour force are improving dramatically.
- The growth potential of B.C.'s aquaculture sector is high compared with that of other producing countries.
- Current restructuring and consolidation of the salmon farming industry is worldwide. As B.C.'s industry is relatively young, it is well positioned to react swiftly to these pressures and evolve to the next level of development.

Constraints:

- Production costs are generally high and compromise the industry's competitiveness.
- Increased world production and competition can be expected.
- Management and business skills, particularly inventory controls and financial/economic principles, are inadequate in some sectors.
- There is limited species diversification within the industry—access to new species and stocks for culture is restricted.
- Minimal economic data exists for the industry as a whole.
- The long production cycles associated with most aquaculture commodities complicates long-term business planning in relation to highly dynamic seafood and protein markets worldwide.
- The mechanisms for financial analysis are limited at present.
- Long production cycles place a heavy emphasis on the need for operating funds.
- There is reduced interest in aquaculture within Canadian venture capital markets.
- There is limited access to government or public funding.
- Chartered financial institutions are reluctant to provide loans to all but the most secure aquaculture companies.

Government Issues

Opportunities:

- A recent Memorandum of Understanding (MOU) delineates provincial and federal responsibilities and confirms government's commitment to foster the sustainable growth of aquaculture. However, this has yet to be fully reflected in policy.
- Public-sector support exists for research and development related to aquaculture.
- Government assists with technology transfer and extension.
- Aquaculture is firmly entrenched in the integrated resource planning process.
- Governments are committed to preserving the integrity of British Columbia's natural resources.
- The B.C. Ministry of Agriculture, Fisheries and Food (MAFF) and the federal Department of Fisheries and Oceans (DFO) represent the aquaculture industry as advocate and lead agency within the provincial and federal governments.

Constraints:

- Aquaculture is often perceived by government agencies as being in conflict with wild-fishery resources rather than an integrated component of the fishery and seafood industry.
- Industry representations to government are fragmented.
- Licensing and tenure assignment processes continue to require refinement.
- Few financial assistance programs exist for aquaculture.
- Certain deficiencies exist in current provincial legislation that governs aquaculture (i.e., designated culture areas, property rights to stocks, and dispute resolution and appeal mechanisms).
- Aquaculture is not clearly defined as agriculture in government legislation or mandates, thus greatly reducing advocacy roles. Aquaculture does not have access to the type of safety net programs afforded other farmers in Canada.
- Potential exists for politicized conflict with other resource users.
- Lack of enforcement of diligent use regulations for Crown land leases is restricting production increases, particularly in the shellfish industry.
- Inadequate enforcement of anti-pollution regulations in other industries is jeopardizing aquaculture's long-term success.
- DFO is also lead federal agency for the wild commercial fishery, which can prove detrimental to its aquaculture clients.
- Policy and regulatory restrictions on accessing fresh water lakes inhibit cost effective production.

Public and Consumer Issues

Environment:

- The public is concerned about preservation of aquatic resources.
- The public is concerned about wildlife protection.
- The public is concerned about the impact of major polluters such as pulp mills, oil spills, and sewage outfalls.

Product Integrity:

- Consumers demand high quality, nutritionally sound, wholesome fish and seafood products.
- Product safety is of paramount importance to consumers.

Awareness

- The general public has a very limited, and in many cases erroneous, knowledge of aquaculture.
- There is a general lack of consumer awareness of seafood product selection, storage, and preparation techniques.
- Consumers are largely unaware of the quality-assurance programs and product-safety inspections procedures in place in Canada for seafood.

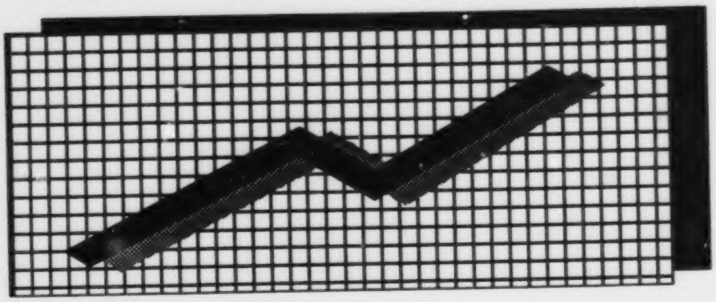
Aquaculture Industry's Development Objectives

British Columbia's aquaculture industry is comprised of a dynamic cross-section of farming enterprises producing of a wide range of seafood products. A casual observer may not see much in common between a thirty-cage salmon farm off Tofino, a five-hectare oyster and clam beach operation in Baynes Sound, and a trout "U-catch" facility in the farmlands of the lower Fraser Valley. To the fish or shellfish farmer, however, it is all agri-business.

Despite the differences in species cultured, husbandry methods employed, and geographic siting, all aquaculture industry commodities share a common goal: sustained business viability and profitability.

Although each commodity has development objectives specific to its character and relevant influencing factors, several common themes are evident:

- **Objective: to increase the demand for British Columbia aquaculture products.**
- **Objective: to maintain and protect British Columbia's aquatic environment.**
- **Objective: to improve the efficiency and competitiveness of the aquaculture industry at all levels.**
- **Objective: to realize consistent government support for a sustainable aquaculture industry in the Province.**



Overall Industry Profile

Scope of the Industry

British Columbia's aquaculture industry dates back to about 1912, when the Pacific oyster was imported from Japan for cultivation. Trout culture started during the 1950s, and salmon aquaculture began during the 1970s. Today the cultivation of these species is well established, and the cultivation of other species such as clams, scallops, mussels, Arctic char, black cod (sablefish), sturgeon, and marine plants is beginning.

The aquaculture industry in British Columbia has experienced a rapid growth in both the total number of licensed farms and the number of applications for Crown land over the past five years.

TABLE I: Active Crown land tenures and applications for marine aquaculture—December 1991

Active Crown Land Tenures

	Finfish		Shellfish		Marine Plants	
	Tenures	Hectares	Tenures	Hectares	Tenures	Hectares
Vancouver Island	117	824	313	1093	4	38
Lower Mainland	52	304	88	430	0	0
Cariboo	0	0	0	0	0	0
Skeena	4	21	0	0	0	0
Total	**173**	**1 149**	**401**	**1 523**	**4**	**38**

Active Crown Land Applications

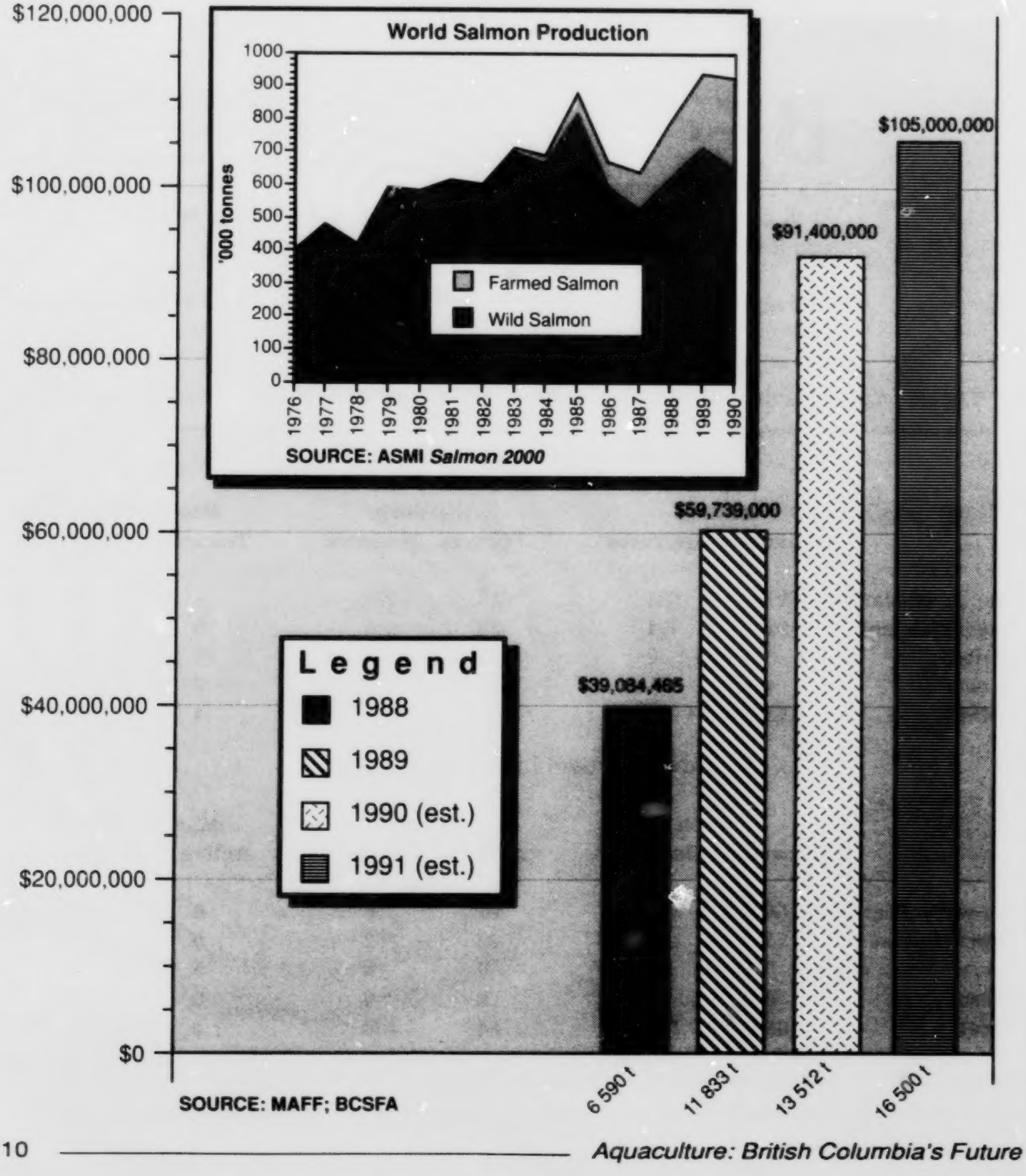
	Finfish		Shellfish		Marine Plants	
	Active	Hectares	Active	Hectares	Active	Hectares
Vancouver Island	55	421	61	306	0	0
Lower Mainland	13	113	23	162	0	0
Cariboo	0	0	0	0	0	0
Skeena	0	0	0	0	0	0
Total	**68**	**534**	**84**	**468**	**0**	**0**

(source: Ministry of Environment, Lands and Parks)

Production

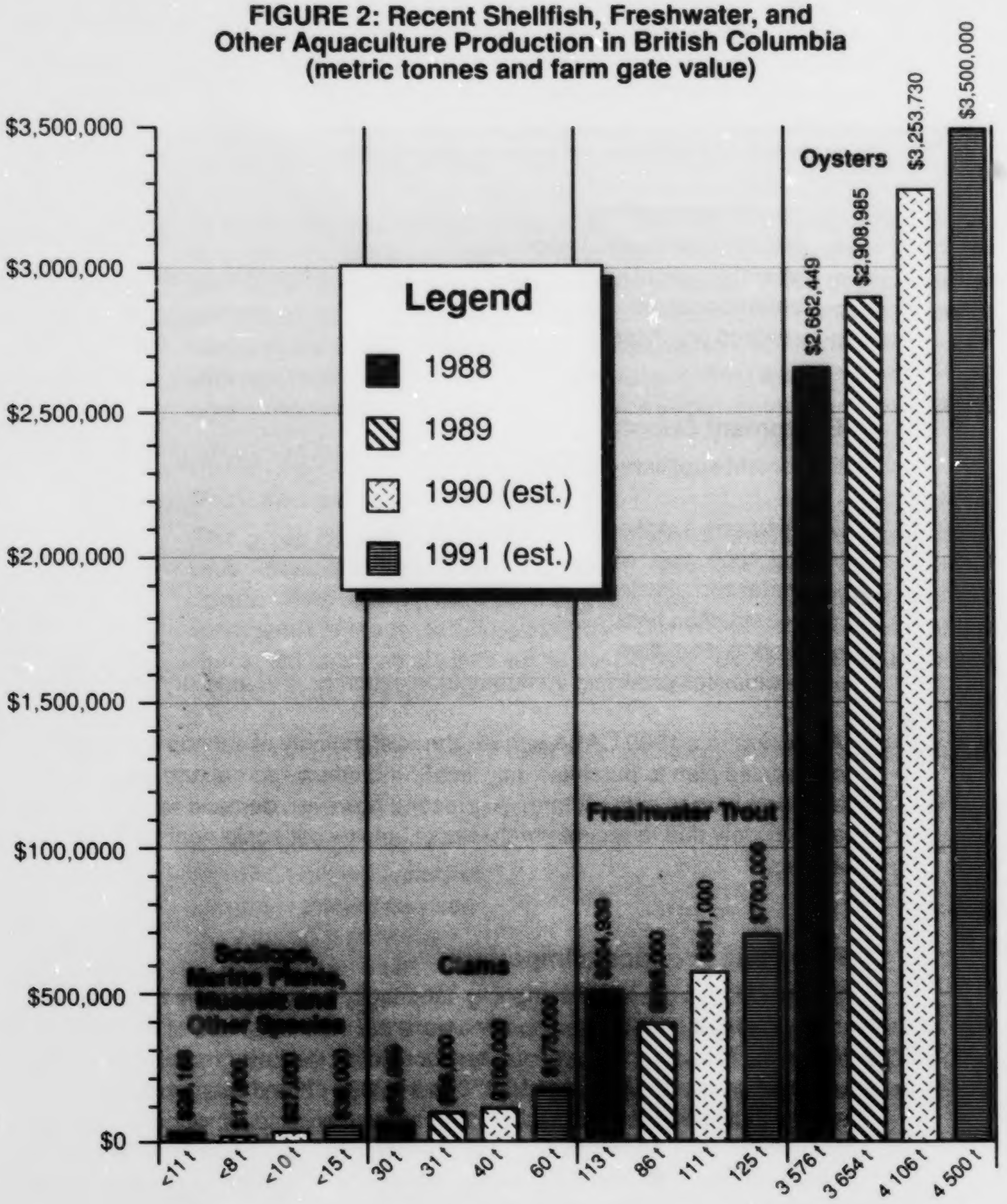
Total sales of aquaculture product in 1990 were worth $95.3 million (see Figures 1 and 2), with major commodity proportions as follows: salmon 95.8%; shellfish 3.5%; and trout 0.7%. It is estimated that total production in 1991 will be worth nearly $110 million.

FIGURE 1: Recent Salmon and Marine Trout Production in British Columbia (metric tonnes and farm gate value)



SOURCE: MAFF; BCSFA

FIGURE 2: Recent Shellfish, Freshwater, and Other Aquaculture Production in British Columbia (metric tonnes and farm gate value)



Total Value of Recent Aquaculture Production in B.C.

1988 — $42,338,920	**1989 — $63,156,785**
1990 (est.) — $95,361,730	**1991 (est.) — $109,410,00**

SOURCE: MAFF

Aquaculture Support Industries

According to a 1988 study by the Canadian Aquaculture Suppliers' Association (CASA), at least 260 companies were providing supplies and services to the aquaculture industry at that time. Most of these firms (78%) were located in the lower mainland or on southern Vancouver Island. The principal suppliers to the aquaculture industries fall into five distinct categories:

- equipment suppliers
- fish feed producers/importers
- pharmaceutical/laboratory/research and development suppliers
- professional services suppliers
- seafood processors.

Equipment Suppliers

Equipment suppliers include:

- sea cage suppliers and manufacturers
- net, rope, and twine makers and suppliers
- metal and plastics fabricators
- construction firms
- marine chandlers
- businesses providing instruments, machinery, and auxiliary goods.

According to a 1990 CASA survey, the vast majority of salmon farming companies plan to purchase only locally manufactured net pen systems, nets, and farm barges in the future. At present, however, demand for new systems appears low due to recent purchases of below-cost equipment from receivership actions.

Fish Feed Producers/Importers

Salmon feed is the largest ongoing commodity supplied to the industry. In 1990, three or four local companies were the main suppliers of fish feed to the industry. Two of the larger firms are located on the lower mainland and one on Vancouver Island. A total of 15 000 to 17 000 t of feed was produced. A recent survey indicated that, although 50% of farms have used imported feeds in the past, only 14% planned to continue purchases of out-of-Province feed in the 1990s. Some U.S. feed companies, however, are making aggressive entries into the B.C. market.

For the most part, local hatcheries use U.S. moist feeds because the product quality is high and comparable moist feeds are not generally available from B.C. manufacturers. Some hatcheries, however, are moving to locally produced dry feeds for freshwater production.

Pharmaceutical/Laboratory/Research and Development Suppliers

Aquaculture operations require the services of private-sector veterinarians, pharmaceutical dispensers, laboratory technologists, and research and development experts who will provide the know-how to improve production methods. Currently, an estimated 16 companies are involved in supplying these kinds of services to the aquaculture industry, whereas in 1986 only a few companies were active.

There are approximately 8 veterinarians currently employed in the private sector who attend to fish health on a full-time basis, and several others who include fish health services as part of their regular practice. While both primary and secondary fish health services (prevention, identification, and treatment of disease) are provided by the private sector, tertiary fish health services (dealing with non-routine disease or industry-wide problems) are being provided by government until the industry and its service sector are sufficiently well established.

Professional Services Suppliers

This group includes biologists, engineers, management consultants, accountants, lawyers, and others who supply professional services to the aquaculture sector. Most of these were providing services to other industries prior to the emergence of the aquaculture industry. The need for these services has waned due to the shortage of funds within the primary sector and a reduction in the industry's rate of expansion.

Consultants in farm management and husbandry practices assist aquaculturists by providing:

- site selection advice
- environmental analysis
- management services
- insurance services
- financial services.

Foreign banks have provided significant financing to the industry and were largely responsible for the development of salmon farming in B.C. Increasing participation by domestic banks occurs as farms demonstrate their financial viability and establish a performance track record.

Seafood Processors

Current government regulations require that farmed salmon must be processed at a federally inspected and registered facility. It is most common for fish farmers to transport their fish to processing plants in one of two ways:

- in live-haul or chilled sea water systems; or
- packed on ice immediately after being killed and bled on the farm.

Either method ensures consumers are getting the freshest possible salmon product.

There is an adequate, and sometimes surplus, capacity for salmon processing in the more than 100 facilities in B.C. Many fish processors in the Province handle wild-caught fish as well as farmed salmon. In recent years, six new processing plants, designed specifically for processing farmed salmon, have been built in coastal communities.

In addition, there are 55 certified shellfish shippers who can process cultured shellfish. B.C. oysters are marketed as shucked product or sold alive for consumption on the half-shell. The certification for shellfish processing facilities is a Canada-United States designation for domestic or export markets.

Employment

More than 1 900 people are currently employed in aquaculture and in directly related industries.

- Salmon farms offer direct, full-time employment to approximately 1 200 persons.
- An estimated 300 people are employed on freshwater fish farms and hatcheries.
- An additional 400 people work on shellfish and marine plant farms.

It is also estimated that a further 5 000 jobs in support industries (i.e., indirect employment) exist as a result of the aquaculture industry.

Education and Human Resource Development

Aquaculture education and technical training is conducted primarily at the community college level in the form of one- or two-year courses. Currently, all four institutions that offer aquaculture programs are having difficulty filling their available positions. This can be attributed to a variety of factors:

- The colleges have collectively graduated several hundred students over the past four years.

- The salmon farming industry, a major employer, is experiencing difficult financial times.
- Farmers are willing to hire workers without any experience, and many of these employees have proven to be quite suitable.
- Expectations of college graduates have been high in terms of expected salary, benefits, and responsibility.
- Pay scales in the aquaculture industry are generally low and benefits poor. Working conditions are sometimes arduous, usually in remote parts of the coast, and require shift work.

People with bachelor's and more advanced degrees in aquaculture are also graduating from British Columbia's universities. These individuals will enter either industry or research programs and contribute to aquaculture development over the next few years. This will be the "first wave" of university graduates specifically trained in aquaculture with an understanding for the activity and its production systems and strategies. This development is welcome, as in the past researchers in aquaculture have been originally trained in other fields. However, it remains unclear whether aquaculture will continue to attract graduate researchers given the existing levels of support and the prospects in B.C. for individuals in this field. It is anticipated that the demands of diversification within the industry will help attract a new breed of applied-research experts and development/extension specialists.

Extension programs developed and supported by the Ministry of Agriculture, Fisheries and Food have been delivered at a number of locations over the years. The contracting of colleges to provide a location and basic infrastructure has given the Ministry flexibility in delivering extension through workshops and making information available at these centres of activity. There are other institutions that offer short courses and workshops to the industry, but the overall effort is not as well coordinated as it might be.

Projected Growth

Over the next five years, the aquaculture industry is expected to experience slow, steady growth. The major aquaculture producer organizations have predicted that the industry's total output will be worth annually about $150 million by 1995. Although salmon will continue to be the mainstay of production, major gains are anticipated in shellfish production with diversification into manila clams and scallops, along with more comprehensive utilization of farm tenures. Freshwater aquaculture is expected to continue its slow but steady development and growth.

Geographic, economic, and social conditions in British Columbia all favour the continued development of aquaculture. The oceanographic conditions in many of British Columbia's coastal areas are ideal for the culture of fish and shellfish, and the limits of the Province's productive capacity are far from having been reached. As well, there is very little conflicting development (in the form of human settlement or other resource-based industry) in the remote areas where aquaculture operations are located (i.e., primarily in the northern half of Vancouver Island). Declines in employment in the fishing and forest industries have created a need for economic diversification in coastal communities, many of which are near areas suitable for the development of aquaculture.

Government Programs

As the lead provincial agency for aquaculture, the B.C. Ministry of Agriculture, Fisheries and Food (MAFF) has committed to assisting aquaculture industry development. The Ministry's goal is to achieve a practical and responsible balance between providing the latitude for private business to devise cost-effective industry practices and ensuring an effective stewardship of public resources. The Aquaculture and Commercial Fisheries Branch of MAFF provides technical assistance and information to all aquaculturists, issues commercial aquaculture licences, and monitors the industry's compliance with provincial aquaculture regulations.

The federal lead agency for aquaculture is the Department of Fisheries and Oceans (DFO). In the interests of developing closer working relations, MAFF and DFO have signed a Memorandum of Understanding (MOU) distinguishing federal and provincial responsibilities. DFO has recently enunciated a position on aquaculture development as described in *Aquaculture Strategy for the 90s: Cultivating the Future*. This document recognizes the department's interface with provincial government and industry.

The B.C. government has allocated funds and resources over the past five years to address some of the more critical issues facing industry. Working as an advocate for industry, MAFF has assisted with research and development of production-related techniques, adoption of sound agri-business principles, and the transfer of technology and information to the industry. Issues addressed by the Ministry over the years include disease control, broodstock development, technical and biological information collection and extension, economic analysis, and environmental interaction assessments.

Unlike other governments around the world, the governments of B.C. and Canada have adopted a policy of minimum financial subsidization for aquaculture. Some direct financial assistance programs are available to the aquaculturist:

- The MAFF provides a Loan Guarantee Program and the Agricultural Land Development Assistance program.
- The Ministry of Economic Development, Small Business and Trade offers assistance through the Small Business Venture Capital and Small Business Incentive Programs.

- Aquaculturists are eligible for provincial Social Services tax exemptions on certain equipment purchases.
- Other potential funding sources for aquaculture operations include the Farm Credit Corporation, the Federal Business Development Bank, and Employment and Immigration Canada. However, minimal financing has been obtained by industry members through these programs.

Aquaculture companies have made very little use of these programs, due largely to the difficulty of meeting eligibility criteria that were not designed for corporate farmers on Crown land.

Several sources of provincial and federal funding for aquaculture research and development exist as well:

- the Science Council of British Columbia
- the National Research Council
- the Natural Sciences and Engineering Research Council
- Industry, Science and Technology Canada
- the B.C. Ministry of Agriculture, Fisheries and Food
- Fisheries and Oceans Canada
- the Department of Western Economic Diversification (offers financial support to encourage technology development and transfer).

These programs have been, and will continue to be, of great benefit to aquaculture.

Key Opportunities and Constraints of the Aquaculture Industry

British Columbia's aquaculture industry is influenced and characterized by a number of distinct opportunities, needs, and constraints.

The Environment

Aquaculture is a non-consumptive, resource-based industry. Water is the culture medium, the conveyer of nutrients and dispersant of wastes, whether passing around oyster longlines or through an ocean net pen or down hatchery raceways. It is clearly in the farmer's best interest to ensure that water quality is maintained at high levels. In order to achieve sustainability for the aquaculture sector, industry and government must work together to preserve the integrity of this valuable public resource.

Our well-circulated waters and irregular coastal geography are nearly ideal for the saltwater aquaculture of cold-water species. However, a complex blend of natural and artificial factors must be considered. Understanding these is critical to the successful development of the industry. As examples of the scope and nature of the relationship between aquaculture and the environment, consider the following.

- When choosing a farm site, consideration must be given to oceanographic characteristics (water depth, wave fetch, current flow, salinity, temperature, dissolved oxygen, etc.), potential for algae blooms, access to transportation infrastructure, proximity to other resource users, etc.

- Due to its dependency on high-quality water, aquaculture is highly susceptible to pollution. Municipal sewage, industrial mills and factories, oil spills, fertilizers or pesticides, land run-off containing fecal bacteria, excessive silt from land erosion, etc. are major concerns for both marine and land-based shellfish and finfish farms.

- Remote farm sites often coincide with seal, sea lion, otter, dogfish, and other wildlife habitat. It is estimated that predation, especially by marine mammals, costs salmon farmers millions of dollars every year.

- Finfish hatcheries and inland trout farms are highly dependent on relatively limited ground water and surface fresh water supplies that meet quality specifications. For sustainability of aquaculture, the integrity of suitable lakes, rivers, and aquifers must be protected from pollution, and aquaculture interests must be assured of reasonable access.

- Knowledge and technical expertise developed by aquaculture companies, coupled with the inherent nature of production and broodstock operation, can potentially compliment and advance wild-stock enhancement efforts. This is especially true of the hatchery and shellfish sectors.

Commercial aquaculture involves the application of agri-business principles and intensive farming methods within a physically and biologically dynamic environment. The quality of B.C.'s aquatic resources and how well the industry adapts to and complements that environment are key to long-term success.

Processing and Marketing

Seafood products destined for sale in highly competitive world markets must be of consistently high quality. Although product safety is very important, anomalies in seafood inspection regulations between nations affect international trade. In recent years, B.C. has been a net exporter of salmon and a net importer of shellfish and trout.

Lack of production coordination between farmers, coupled with seasonal variations in harvesting, make it difficult for industry to exert any degree of control over commodity sales. B.C. products are largely undifferentiated from those of competitors, and there is a lack of value-added product development locally. In addition, our industry has few promotional dollars. In a commodity driven market, this results in B.C.'s producers reacting to price levels set and controlled by seafood distributors and wholesalers.

The industry must take full advantage of its proximity to the large U.S. market. Americans consume vast amounts of protein foods, and per capita consumption of seafood products is growing. Fresh, wholesome B.C. aquaculture products can potentially capture a significant market share south of the border. However, dependency on export markets can also leave the industry vulnerable to exchange rate fluctuations and tariff and non-tariff trade barriers.

The industry can reduce its vulnerability to market supply-and-demand fluctuations through product diversification. Polyculture and/or raising of stocks that broaden harvesting windows will enhance marketing flexibility, as will development of "consumer friendly" product forms.

Farm Viability

As with any agri-business sector, the sustainability of aquaculture is dependent on its long-term profitability. Companies must have a detailed understanding of their production costs, possible returns on investment, and the availability and cost of capital. Very little comparative financial data on the aquaculture commodities is available, and analytical mechanisms within industry are limited. In an industry where there is minimal product differentiation and supply exceeds demand, the lowest-cost producer will endure.

In order to effectively maximize farm competitiveness, several direct and indirect factors must be addressed:

Inventory Losses and Mortalities

Crop losses have a negative effect on production costs, volume, and revenues. Finfish farmers experience both acute and chronic losses due to disease, algae blooms, predation, and escape. Shellfish growers suffer stock losses due to pollution, toxic blooms, adverse weather conditions, theft, and predation. These are prime areas for focussed research and applied development.

Technology and Husbandry

Growers must constantly refine farm procedures to improve efficiencies, better utilize farm equipment, and reduce production costs. Advances are needed in several areas, including inventory verification, disease control, shellfish harvest systems, rearing techniques, and fish waste management. Aquaculturists must become even more sensitive and knowledgeable about the interactions between water quality and the growth and survival of their livestock.

Production Inputs

Government and aquaculture companies must place emphasis on:

- accessing the best possible genetic seed stocks from B.C., North America, and abroad
- the development within B.C. of domesticated broodstock to ensure access to genetically superior seed and eggs
- securing and preserving high quality "farmland" and aquatic resources for aquaculture and the preservation of associated water quality
- developing and improving farm management and business skills
- the refinement of economic data collection and subsequent analysis and bioeconomic planning
- ensuring that farm workers' safety is adequately addressed
- the manufacture of high-quality feeds designed for species and culture conditions in B.C.

Diversification

Finfish and shellfish growers have limited flexibility in managing harvest periods to maximize marketing opportunities. Increased diversification of sexually modified stocks and new species reared by aquaculture companies will enhance revenue opportunities and improve risk management. Further applied research and development is needed to ensure the achievement of cost-effective diversification.

Financial

A wide range of capital investment can be involved in the establishment of a farming operation. However, the long production cycles associated with virtually all aquaculture commodities places heavy emphasis on the need for operating funds. Public equity markets and government financial assistance programs are either inaccessible or non-existent for aquaculturists. In addition, most chartered lending institutions are reluctant to finance all but the most financially secure of successful farming companies.

The Role of Government

Aquaculture exists within a complex matrix of overlapping government mandates and jurisdictions. No fewer than ten provincial ministries and federal departments influence the business climate for aquaculture in British Columbia. In addition, regional and local governments are responsible for zoning by-laws, which can be heavily influenced at public hearings by vocal special interest groups. It is not surprising that inconsistent and sometimes conflicting policies have emanated from different agencies. Variances in the interpretation and application of policy and regulations are found even within specific departments or ministries.

In 1988, a formal Memorandum of Understanding (MOU) was established to clarify the co-operative framework within which the provincial and federal agencies could work to meet the needs of industry. This document delineates the responsibilities of each government in the management of the aquaculture industry.

Under the MOU, the Province is responsible for:

- extension programs and training
- aquaculture licensing and regulatory monitoring
- certain types of research and development
- collection of industry data and information
- environmental monitoring
- integrated resource planning.

The B.C. Ministry of Agriculture, Fisheries and Food (MAFF) is the provincial lead agency and advocate for the Province's aquaculture industry. To advise the Minister on aquaculture issues from the perspective of a whole range of coastal resource user groups, the Minister's Aquaculture Industry Advisory Committee (MAIAC) has been established. Other provincial ministries that influence aquaculture operations and/or development are: Environment, Lands and Parks; Economic Development, Small Business and Trade; and, Finance and Corporate Relations. In 1987 the Provincial Aquaculture Steering Committee (PASC) was formed to provide interministerial program coordination and policy discussion. However, PASC has not met for the last two years, a situation that should be rectified considering the recent change in government.

The Department of Fisheries and Oceans (DFO) is the federal lead agency for aquaculture. Other departments involved with the industry include Health and Welfare Canada; Environment Canada; Industry, Science & Technology Canada; and Agriculture Canada. The federal government is primarily responsible for:

- wild resource management and protection, including habitat
- water testing
- product testing
- fish health protection
- research
- veterinary regulations
- drug use and monitoring.

In addition, the two senior governments agree to:

- facilitate research, development, and technology transfer
- develop and maintain referral mechanisms to address fish health, habitat, and harvesting concerns
- support the Aquaculture Transplant Committee
- maintain an MOU Management Committee, which provides a forum for consultation on development and regulatory issues with the aquaculture industry (as represented by the Industry Advisory Committee [IAC]).

In 1989, the *B.C. Fisheries Act* was amended to create a licensing requirement for commercial aquaculture facilities, and the Aquaculture Regulation came into being. The administrative and bureaucratic procedures related to licensing continue to require refinement and streamlining. Also, several legislative deficiencies exist in the array of provincial statutes that govern aquaculture, including a lack of laws or regulations to govern:

- the creation of designated aquaculture areas
- dispute resolution and appeal mechanisms
- the creation of property rights to the stocks.

Both MAFF and DFO acknowledge aquaculture as farming, but neither has chosen to treat aquaculture as agriculture with respect to regulations or safety-net programs.

Government has chosen not to heavily subsidize aquaculture businesses in B.C. A few financial assistance programs are offered by the Province, but the industry has largely grown and developed, subject to market forces, with private-sector capital. This is an industry that has, for the most part, made it on its own financially.

For this industry to survive and continue contributing positively to the provincial economy, stronger advocacy by government lead agencies is needed on the issues of pollution and private property rights. Such efforts should be complemented by fair and equitable enforcement of realistic regulations. Industry and government interactions can be improved through the establishment of practical mechanisms for two-way communication **and** consultation. A recent step in the right direction has been the creation of the Baynes Sound Shellfish Advisory Committee which provides an ad-hoc process for consultation between BCSGA and MAFF on policy, procedures, and documentation changes.

At the working level, bureaucrats usually have limited first-hand knowledge of, or adequate appreciation for the priorities of agri-business and pressures of commerce. Misunderstandings can arise, especially during times of economic hardships within industry. The establishment of executive exchange programs between government and industry would help to improve interactions and understanding between the public and private sectors.

Public Concerns and Consumer Awareness

Since the late 1980s the world has moved rapidly to a higher state of global environmental consciousness. An ever-growing number of British Columbians are voicing their concerns over how public resources, especially natural resources, are managed. The recurring themes are ecological preservation and wildlife protection.

At the same time, consumers are increasingly demanding healthful and wholesome foods. Although not everyone is prepared to pay the required premium for truly organic foods, nutritious, chemical free, environmentally friendly products are in ever-increasing demand. Consumers, especially in North America, are spending more of their food dollars on seafood.

The University of Rhode Island conducted a recent survey and study of consumer's perceptions as to seafood quality. This survey found:

- 43% of consumers buying seafood asked questions indicating a low knowledge level about the product.

- The top two safety concerns were pollution and shellfish toxins.
- In general, seafood was not considered very safe by the majority. Salmon and cod had lower risk ratings than mussels, oysters (highest), chicken, and beef.
- The most frequently asked questions concerned where and when the seafood was caught.
- "High quality" indicators are (in order of importance to the consumer): it is fresh, has good colour, smells right, is high-priced.
- Some reasons given for increasing consumption of seafood concerned personal health and change in tastes.

The potentially negative attitude of consumer advocate groups toward certain intensive farming practices as well as animal welfare issues, environmental interactions, antibiotic use, or seafood contamination due to pollution, may represent problems for the industry.

Aquaculture has the opportunity to complement these positive trends and satisfy most concerns. The industry serves as an early indicator of aquatic resource degradation. Cultured species, particularly shellfish, are very sensitive and in many cases susceptible to pollution and other water quality changes. Though shellfish may not themselves be directly impacted by pollutants, they do concentrate contaminants and may be rendered unfit for human consumption. Depuration can purge many such contaminants from shellfish to once again make them safe for market consumption. But it is this ability to concentrate contaminants without dying that make shellfish such good pollution monitors. *Aquaculturists have a vested interest in ensuring that neither their own culturing practices nor the activities of other industries adversely affect water quality at their sites or the health of their stocks.*

As to product integrity, aquaculturists must ensure that the highest food quality standards are maintained and public health is not compromised. Seafood is blessed with a long-standing reputation as a wholesome source of protein and has more recently been identified as one of the best sources of Omega-3 fatty acids. This is key to the successful marketing of seafood products. However, due to a general lack of public awareness of product selection, storage and preparation techniques, random and sometimes devastating fluctuations in demand have had catastrophic effects on certain industry sectors. While the consumer must become better educated about seafood if market demand is to grow, industry needs more information on consumers, data that would normally be provided through awareness and trial-and-usage studies.

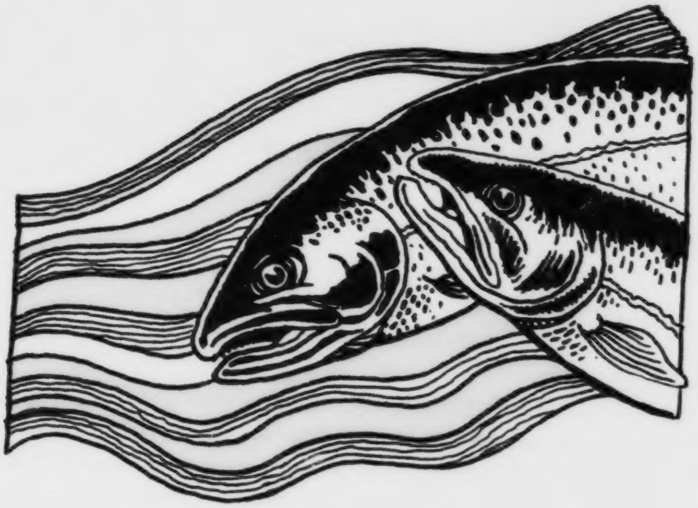
Industry Representation

This Province's aquaculture industry as a whole is comprised of several hundred independent producers spread over a broad geographic area, and all are striving to achieve similar agri-business goals and objectives. This developing industry can ill afford internal conflicts and competition. The real competition exists from competitors outside of British Columbia, not from within the B.C. industry.

The aquaculture industry lacks a strong, cohesive voice. There are currently eleven commodity and regional aquaculture associations in B.C. In addition, industry's interests are represented nationally by the Canadian Aquaculture Producers Council and the Aquaculture Association of Canada. The B.C. Aquaculture Research and Development Council (BCARDC) provides focus for aquaculture research and development initiatives in the Province.

Participation by growers on association and industry/government committees declines during tough economic times, precisely when industry must ensure its needs are understood and met. Rationalizing the total number and scope of these committees, as well as recognizing the financial contribution farmers make in attending meetings, would enhance participation and, therefore, the effectiveness of these activities.

Salmon



Development Objectives for the Salmon Industry

Since its inception, the British Columbia salmon farming industry's goal has been to achieve long-term business viability and profitability.

With the recent collapse of worldwide salmon prices, the formula for success has been expanded to add emphasis to the crucial variables of market dynamics, production competitiveness, government interactions, and the environment.

The following strategic objectives, which reflect industry's priorities, have been identified to address the issues affecting development of salmon farming in B.C.

Objective 1: to increase the demand for British Columbia salmon at a price that will sustain a viable salmon farming industry

- The industry must develop mutually acceptable strategies with producers outside of the Province to increase the demand for salmon products in the U.S. The sector should strive to secure adequate funds from both industry and government to support such marketing initiatives.
- Strategies are needed to improve the "consumer friendly" image of salmon, and to develop and promote value-added product lines to improve the sector's profile and realize better profit margins in the highly competitive protein food market.
- The traditional seafood distribution systems need improvement in order to increase financial returns to the farmers.

Objective 2: to improve salmon production efficiency and cost competitiveness

- Increase research into diseases affecting salmon and develop effective methods of prevention, detection, and control.
- Enhanced access to the varieties and quantities of salmonid species and stocks is deemed necessary for increased production and product diversification.
- Improve production efficiencies through the adoption of improved husbandry methods, new technology, and refined management practices, including the development of a comprehensive, industry-driven record-of-performance management tools for salmon farmers.

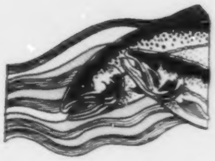
Objective 3: to realize focussed and consistent government support for a sustainable salmon aquaculture industry

- The industry must develop and maintain effective mechanisms for industry and government communication and interaction in order to:
  - ensure industry access to high-quality aquatic "farmland"
  - refine and rationalize various government mandates, regulations, and interactions affecting aquaculture
  - conduct research, development and extension services that relate directly to the needs of industry.
- Aquaculture's advocate agencies, MAFF and DFO, must represent the interests of the industry, within government and elsewhere, in a more effective manner.

Objective 4: to promote and maintain a high-quality aquatic environment and to produce wholesome salmon

- Fair and consistent enforcement of regulations governing protection of our marine and fresh water resources is needed.
- Government must improve seafood testing methodologies and application so as to achieve more timely and consistent verification of the wholesomeness and high quality of B.C. salmon products.
- Salmon farming, by definition, is dependent on pristine water quality. The industry will continue to operate in an environmentally responsible manner and work towards ensuring that other resource users respect aquaculture's requirement for a high-quality aquatic environment.

Salmon: Industry Profile



Salmon farming is a new industry in British Columbia. In the early 1970s, the first salt-water farms were established in Alberni Inlet on Vancouver Island and Sechelt Inlet on the mainland. The industry has experienced rapid growth since 1985 and is currently in a stage of transition and rationalization. While developing and maturing as an agri-business sector, salmon farming has relied on a relatively inexperienced work force. However, this has not prevented the industry from making impressive contributions to the Province's economy. In 1990, the salmon farming industry's landed value equivalent was over $90 million. This is 35% of the B.C. commercial fishery's five-year average landed value of $259 million during 1985-1989. In comparison with other agri-sectors, finfish aquaculture was ranked the fourth largest agricultural commodity in B.C. after dairy, cattle, and poultry—based on farm gate values—and accounted for nearly 5% of B.C.'s total agricultural worth. Just three years earlier, finfish was ranked thirty-third.

The marine salmon industry is currently composed of 173 tenured farms utilizing 1 149 hectares of Crown aquatic land. This represents a 16% decrease in the number of farms and a 19% decrease in the number of hectares available for culture since December, 1989. As well, an additional 68 applications for marine farm tenures were under review as of December, 1991. The primary species being cultured are chinook and Atlantic salmon. Smaller quantities of coho and salmon (or marine trout) are also produced.

During the initial pioneer stages of the industry's development, farmers focussed on establishing grow-out sites on the Sunshine Coast. The perceived advantages were close proximity to suppliers, transport infrastructure, and markets in Vancouver. By the late 1980s, much of the Sunshine Coast was considered poorly suited for salmon culture. Industry realized the need to seek out coastal areas with better water-quality characteristics, as well as fewer potential conflicts with upland owners and other resource users. Expansion has shifted to the Campbell River region and the West and North Coasts of Vancouver Island. Initial expectations of expansion on the North Coast (Prince Rupert area) have not been realized, largely due to the high cost of creating a new infrastructure and harsh environmental conditions for marine operations. Currently, over 60% of the existing and proposed farms are located near or accessed directly from Vancouver Island. Table 2 provides information on composition and size of the industry.

TABLE 2: B.C. Salmon Farming Industry Statistics

	1986	1987	1988	1989	1990	1991
Companies in Operation	60	70	102	75	52	55
Farm Tenures	82	152	207	222	206	173
Total Tenure Area (ha.)	283	746	1 138	1 357	1 413	1 149
Operating Farms	69	82	118	140	120	125
Hatcheries	32	37	46	35	25	26

In response to public concerns about the possible impacts of fish farming in British Columbia, the provincial government instituted a moratorium on the issuance of fish farm tenures from October, 1986 to March, 1987. A Commission of Inquiry chaired by David Gillespie was established to conduct a series of public forums and prepare recommendations to government on various aspects of finfish aquaculture, most notably: the effect on commercial fishery operations and markets; environmental effects and effects on wild fish stocks; government approval and monitoring procedures; and, the involvement of local governments and interest groups in adjudicating fish farm tenures.

Gillespie's report generated fifty-two recommendations to government. Following acceptance by Cabinet, new provincial policies were built around the results of the public inquiry to ensure that the fish farming industry developed compatibly with other coastal users. Coastal Resource Interest Studies (CRIS) were conducted for the Desolation Sound/Johnstone Strait regions, the Sunshine Coast, the southern Gulf Islands, Nootka and Clayoquot Sounds, and the Broughton Archipelago in the Port McNeill area. These studies gathered input from a myriad of coastal resource users, from commercial fishermen to sea kayakers. Their input was used to create guidelines on where fish farms can be developed, and where other interests take precedence.

Another important recommendation of the Gillespie inquiry resulted in the implementation of the *Aquatic Waste Control Regulation* in 1988. This regulation stipulates that all marine net-pen operations must:

- undertake an environmental monitoring program and submit extensive data on water quality, feed usage, water currents, and benthic impacts

- submit any additional information requested by the Regional Waste Manager, Ministry of Environment, Lands and Parks (MELP)
- notify MELP of any changes in the farm's operational plan or of any pollution incidents
- take remedial action to deal with pollution
- make contingency plans for excessive fish mortalities.

Under new mandates arising from Cabinet's acceptance of the recommendations, the former ministries of Agriculture and Fisheries, Crown Lands, Environment, and Municipal Affairs, Recreation and Culture implemented wide-ranging policies, regulations and guidelines for administering B.C.'s fish farming industry. The B.C. Salmon Farmers Association published Codes of Practice and Quality Control for its members.

Many salmon farms in B.C. harvested their first major crops in 1989 and intended to use the resulting revenues to reduce debt loads and fund future operations. Unfortunately, 1989 saw a substantial increase in world salmon production, and prices dropped by 30% to 40% as supply outpaced demand. Although B.C. production more than doubled, industry revenues increased by less than 60%. These financial problems were further compounded by very intense plankton blooms in the Sunshine Coast area.

The result has been a process of rationalization and corporate consolidation. Twenty-six companies, representing 30% of all active salmon farming companies in the Province, were placed in receivership in the last two years. Many of these firms were struggling with a combination of business problems, including highly leveraged financial structures, high production costs, and environmentally poor grow-out sites. Another major contributing factor were the costs associated with learning to culture non-domesticated Pacific salmon species and the adoption of unproven biotechnology (e.g., neutered coho) in the mid-1980s. When market prices fell below the cost of production, these firms could no longer generate sufficient cash flow to satisfy creditors. Though the majority of failed farms along the Sunshine Coast have been removed from production, 70% of failed firms in other regions have been purchased as going concerns by new or existing aquaculture companies. Virtually all assets involved in these receiverships have been purchased by other B.C. salmon farmers.

In the 1990s, the industry will recover from this downturn, as the major producing countries are expected to control production and new markets are anticipated to open up for development. The market conditions for B.C. fresh and frozen salmon, both farmed and wild, will remain challenging, however. Rewards will be realized only if comprehensive marketing and distribution strategies are successfully implemented.

Vertical business integration is becoming more prevalent in aquaculture, though not all farmers have chosen this form of diversification. Some 54% of B.C.'s operating salmon farm companies concentrate strictly on growing salmon. Of the large corporate farming firms, nine are owned by major agri-business, seafood, or feed supply companies and operate their own hatcheries and/or processing plants. Many also have their own sales force within the company. These integrated corporations account for over 75% of the industry's total production.

Salmon farming in B.C. was largely initiated by foreign capital, primarily Norwegian. Many companies and individuals brought expertise developed in the European salmon aquaculture industry to Canada's west coast. A survey of 54 salmon farms undertaken by the DPA Group in 1986 revealed a total foreign investment worth $9 million. By 1989, total foreign investment in aquaculture was estimated at $100 million for 135 farms, representing one-third of total investment in the industry.

The rationalization and consolidation of salmon farming in B.C. has a direct influence on how programs in support of the industry should be delivered.

Today, foreign investment exists in all sectors of the industry—farming, equipment manufacturing, and provision of related services. The absolute dollar value of foreign investment in the industry has increased along with the total investment, but the ratio of foreign to domestic investment appears not to have changed substantially. (Figures pertaining to this are difficult to obtain and substantiate, particularly when companies sell public shares that may be owned worldwide; however, a study prepared in 1990 by Coopers and Lybrand Consulting Group on the financial structure of the industry in B.C. determined that 62% of all salmon farming companies were Canadian controlled and that these companies accounted for 41% of the industry's total production capacity.)

The Province's salmon farming industry is represented primarily by the B.C. Salmon Farmers Association. The BCSFA aims to promote the interests of its members in each of the following areas:

Generic Marketing and Promotion of B.C. Farmed Salmon

The BCSFA has successfully negotiated joint funding between industry and the federal Western Economic Diversification Office and B.C. Trade and Development Corporation for a $3.2 million, five-year market development program. The program was initiated in the fall of 1991 with the creation of the B.C. Farmed Salmon Institute.

Government Relations

The BCSFA represents the salmon farming industry's interests and concerns on a wide variety of issues to various federal and provincial government agencies.

Science, Research and Development
The BCSFA encourages and assists in co-ordinating R&D projects for the industry and facilitates the establishment of priorities.

Public Relations
The BCSFA acts as a conduit for public information on B.C.'s salmon farming industry and its products.

Three associations represent the interests of salmon farmers regionally:

- Campbell River Aquaculture Association
- Sunshine Coast Aquaculture Association
- North Island Mariculture Association.

Production Overview

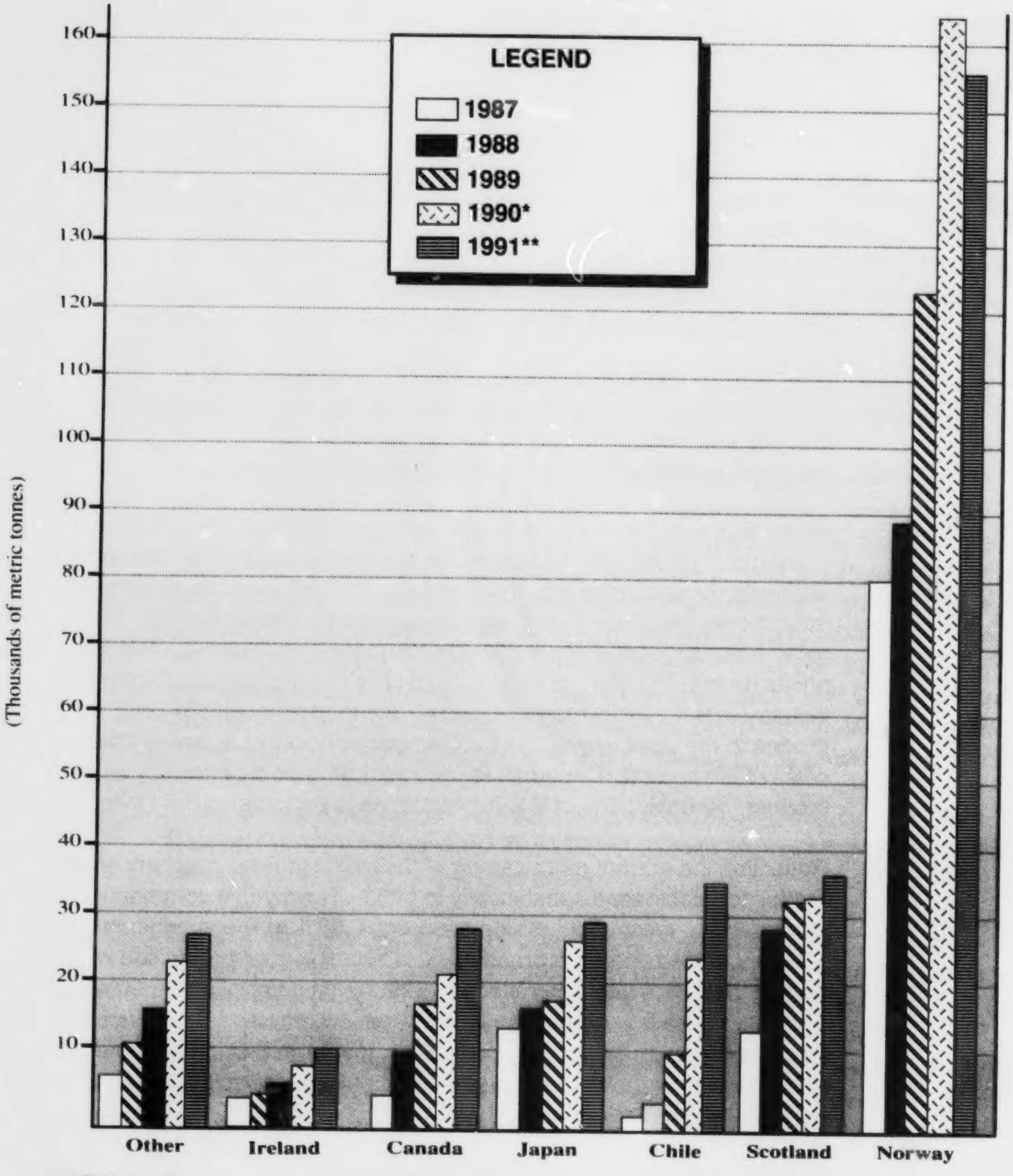
B.C.'s salmon farming industry has developed during a period of rapid expansion of salmon culture around the world. International competition for markets and lowered production costs will be dominant factors influencing our industry's success through the next phase of development.

World supply of farmed salmon has increased from 47 800 t in 1985 to an estimated 318 000 t in 1990 while the commercial wild catch has remained relatively constant (see Figures 3 and 4). This net increase in global supply dramatically reduced world prices for salmon in 1989 and 1990. The impact on salmon farming industries worldwide has been considerable. Farmed salmon prices dropped by 30% to 40% in 1989 precipitating a restructuring of the industry in B.C. Profit margins, particularly for many chinook producers, have eroded to the point where 1991 selling prices hover at or below many farmers' costs of production. Canadian farmed salmon is sold principally as fresh product. Roughly 70% of B.C.'s production is exported to the United States.

Reflecting the current restructuring of the local industry, hatchery smolt production decreased substantially in 1990. Twenty-five commercial hatcheries produced in excess of 35 million eyed-eggs, 98% of which originated from privately owned domestic broodstock. Though overall production was down, hatchery survival rates improved in 1990, ranging from 75% to 90%. In addition, the shift to production of the larger Atlantic and S-1 chinook smolts has resulted in an increase of biomass output from B.C.'s hatcheries. Table 3 provides a breakdown of salt-water smolt entry, by species, over the last five years as well as estimates for 1991.

The industry's original culture efforts focused on chinook and coho species up until the mid to late 1980's. However, coho salmon were found to have significant early maturation problems. Neutered coho culture was tried in 1987 in an unsuccessful attempt to solve this problem. Coho now comprises only a small component of the production mix of the industry.

FIGURE 3:
World Farmed Salmon Supply, 1987 to 1991

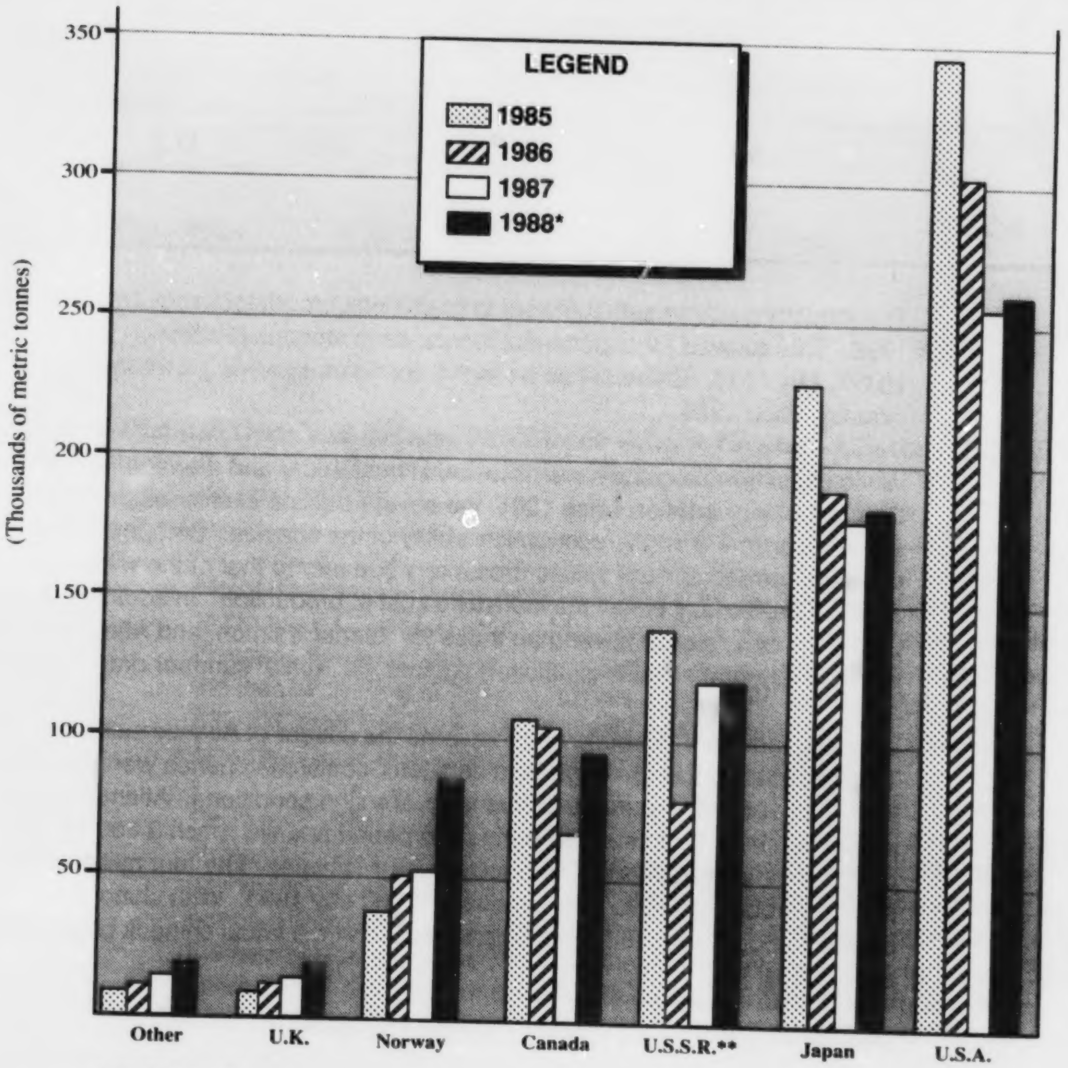


* Preliminary Figures

** Estimates

SOURCE: FAO/Globefish; Bill Atkinson's News Report and various aquaculture associations; DFO; Alaska Seafood Marketing Institute; Seafood International; Fish Farming International

FIGURE 4:
World Wild Salmon Harvest, 1985 to 1988



* Preliminary Figures

** 1988 estimates unavailable, so 1987 data is repeated

SOURCE: FAO/Globefish

TABLE 3: Smolt Introductions Into Salt-Water Farms (millions)

Species	1986	1987	1988	1989	1990	1991
Chinook	2.6	8.1	11.8	24.5	13.5	8.0
Coho	2.4	5.4	6.9	3.1	0.8	0.5
Atlantic Salmon	0.3	0.5	0.7	1.3	2.4	4.0
Salmon Trout	—	—	—	0.08	0.35	0.3
Sockeye	—	—	—	—	0.12	—
Total	**5.3**	**14.0**	**19.4**	**29.0**	**17.2**	**12.8**

(source: BCSFA)

The industry became self-sufficient in its chinook broodstock requirements by 1988. This allowed for exponential increases in chinook production to over 10 000 t by 1989. Chinook has been the dominant species grown in the industry since 1989.

While considerable gains have occurred in husbandry and management practices of chinook salmon since 1985, the severe decline in chinook prices places a major constraint on the economic viability of the species. Compounding the problem, farmed chinook prices drop every summer to that of the wild fishery, which is predictably below the industry's cost of production. In addition, chinook prices are consistently lower than those for Atlantic salmon, and Atlantic salmon prices are typically better-cushioned against the annual summer drop in prices.

There is, therefore, a strong trend towards the culture of Atlantic salmon in B.C. The first Atlantic salmon eggs from certified Scottish hatcheries were imported to B.C. in 1985 and reared under strict quarantine conditions. Atlantic salmon production has grown steadily during this period and will reach 3 400 t in 1991, or 20% of the industry's total production (see Table 4). The four million Atlantic smolts introduced in 1991 will produce 10 000 t by 1993. With chinook salmon production declining, Atlantic salmon production will equal chinook production by 1993.

New development work is also underway with the culture of Pacific sockeye salmon. However, preliminary results indicate poor performance by this species in marine net pens.

TABLE 4: B.C. Salmon Farming Production, Selling Price, Total Value, and Estimated Cost of Production

Species	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Chinook	87	949	3 550	8 514	10 396	12 800
Coho	304	790	2 775	1 815	1 296	225
Atlantic Salmon	—	—	80	1 280	1 640	3 400
Salmon Trout	9	192	185	274	180	75
Total Production	**400**	**1 931**	**6 590**	**11 883**	**13 512**	**16 500**
Total Value ($million)	2.7	12.7	38.5	59	91	105
Average Selling Price ($/kg)	6.82	7.55	5.93	6.62	6.56	6.36
Average Cost of Production *($kg)	—	—	—	7.06	6.31	6.30

* source "Estimated Costs and Returns for Chinook Salmon Production in the Campbell River Area," 1989 &1990, MAFF Information Bulletins No. 28 and 28-1.
(all other sources: MAFF; BCSFA)

Major diseases, such as bacterial kidney disease (BKD) and vibriosis, continue to plague B.C. salmon farms. Marine anemia and furunculosis are incipient diseases that could also cause problems. It is estimated that disease results in the loss of 15-30% of fish prior to harvest, a direct economic loss of between $20-$30 million annually. Additionally, some areas have been hit repeatedly by blooms of toxic algae, which have caused severe fish losses.

Rearing of salmon smolts in lake net pens has been adopted as a cost-effective strategy in Scotland and Chile. Because it requires less capital investment, net-pen rearing is less costly than flow-through, land-based hatchery rearing using pumped ground water. As well, it allows for access to more water. Moreover, the quality of smolts from lake facilities is generally better, as far as can be determined from the limited field trials conducted to date. Net-pen rearing in lakes is particularly appropriate for smolts which have to be reared over a year or more (e.g., for Atlantic and S1 chinook smolts, which are gaining favour in the industry).

The technology of lake rearing is relatively simple, and there are currently four private sector lake net-pen rearing operations in the Province. The Ministry of Environment, Lands and Parks has also used various lakes to culture fish for enhancement for over ten years. However, access to suitable lakes is contentious. Resistance to the expansion of private sector lake rearing has resulted from perceived impacts such as destruction of recreational fishing opportunities, potential negative interactions with native fish stocks, and disease transfer possibilities. In fact, the current information base does not support the validity of these concerns.

Industry views lake pen rearing as being crucial to the cost-efficient production of Atlantic and S1 chinook smolts. Lake rearing can reduce a company's smolt production costs by as much as 30%.

Market Profile

Virtually all of B.C.'s farmed salmon production is sold fresh. In contrast, just 3% of the Province's commercial salmon catch is typically sold as fresh product. This highlights the market separation of B.C.'s commercial fishery and salmon farming industries.

In 1990, close to 70% of all B.C. farmed salmon was exported to the U.S., of which half was consumed in California. Just over 20% was distributed across Canada, including 8% sold locally in B.C. Less than 10% was sold to Japan.

Significantly, B.C. is now the leading exporter of farmed salmon to the all-important U.S. market, having surpassed Norway for the first time (see Table 5). In 1990, the U.S. International Trade Commission found Norway guilty of selling salmon into American markets at less than fair value. A countervailing duty was imposed on Norwegian salmon, causing Norway's U.S. exports to decline to almost nil.

The product is primarily sold fresh, gutted, and with the head on. It is distributed through channels established to handle fish from the wild fishery. There is no distinct distribution system set up specifically for farmed salmon, a situation some industry members see as being detrimental to price stability and profitability. This has led to the recent formation of farmed fish distribution and marketing firms by the two largest, vertically integrated aquaculture feed companies in B.C. In general, the industry has not favoured the development of a regulated salmon marketing board in B.C.

World salmon prices have been depressed since 1989 for a variety of reasons, including:

- record commercial harvests of wild salmon worldwide (Alaska enjoyed its top harvest ever in 1991, 322 000 t)
- increased world farmed salmon production to 300 000 t
- high inventories of frozen and canned salmon, which contribute to the current excess of supply

TABLE 5: Imports of Farmed Salmon to the United States

Country	1988		1989		1990		1991*	
	Tonnes	%	Tonnes	%	Tonnes	%	Tonnes	%
Canada								
British Columbia	4 200	24	8 670	31	9 113	31	12 600	39
New Brunswick	1 800	10	2 800	10	3 900	13	5 400	17
Subtotal	6 000	34	11 4700	41	13 013	44	18 000	56
Norway	8 930	51	11 509	41	7 699	26	800	3
Chile	1 175	7	2 062	7	7 058	24	8 700	28
Others	1 306	8	2 727	11	1 982	6	4 400	13
Total	**17 411**	**100**	**27 768**	**100**	**29 752**	**100**	**31 900**	**100**

source: U.S. National Marine Fisheries Service
* 1991 figures are forecasted

- a lack of coordinated marketing and selling for all salmon products as compared to other protein food sources
- the collapse of the Norwegian Fish Farmers Sales Organization late in 1991, resulting in uncertainty over the fate of 30 000 t of frozen Atlantic salmon.

World production of farmed salmon peaked in 1991 and is expected to decline by 5% over the next two years. This is largely due to the continuing financial pressures facing the industry worldwide. Norway's industry is undergoing a major restructuring, which will cause production to decline from 163 000 t in 1990 to 135 000 t in 1993. Scotland's output will decline from 1991's 36 000 t to 25 000 t in 1992 and 1993. All other European producers will also lower their production over the next two years. Chile's salmon production is expected to stabilize at 35 000 t. In Canada, B.C. and New Brunswick will also level off production until 1993 at 18 000 t and 10 000 t, respectively.

Changing lifestyles are creating an ever growing demand for "consumer friendly," easy-to-use product forms. Many seafood buyers do not want to deal with fish heads, tails, and scales. The development of new value-added products should be considered essential if market share and profit margin are to be significantly expanded. Some farmers maintain that it will be difficult to use farmed salmon in many "meal" type convenience products, given supplies of reasonable quality, low-priced salmon from the wild fishery. Compilation and analysis of the information needed to determine whether a move to all levels of value-added production is a reasonable option for farmed-salmon producers is not yet complete.

Consumer education is required, in part, to set the record straight in terms of farmed-fish quality and safety. There is a continuing need to counter false claims, and at the same time to increase consumer awareness of farmed salmon as a wholesome, healthy food. This can be achieved through a focussed communications plan encompassing advertising, newspaper articles, etc. Canada has disciplined and well-regulated seafood inspection programs in place. The recent success of farmed salmon at the Culinary Olympics is a good starting point for building positive consumer awareness.

B.C.'s close proximity to the vast U.S. market is one of the industry's primary competitive advantages. West coast salmon farmers can access any American marketplace within 24 hours of harvest. Market research has shown that U.S. consumers perceive Canada as the premier supplier of fresh salmon to their country. Canada is also well-known as the leading trading partner of the U.S. B.C. farmed salmon is therefore ideally positioned to exploit these advantages.

The problems and challenges facing the B.C. salmon farming industry are the same as those currently being experienced by other salmon-growing areas. By placing emphasis on production rather than marketing, farmers in Scotland and Norway have experienced financial difficulties over the past two years. In the past, husbandry and business inefficiencies were compensated for by high market demand and corresponding prices. Markets are changing, however, and farm production costs are exceeding returns. Worldwide, industry is recognizing that better control must be gained over production costs if farmers are to survive in increasingly competitive markets.

In most other major salmon-producing countries, salmon farming has been "government led." The primary initiative to establish a salmon farming industry was undertaken by governments with major financial programs supporting development. In B.C., the private sector took the initiative to start and drive the growth of a new, dynamic industry. Development evolved within an acceptable framework defined by the provincial government, which took a relatively "hands-off" approach in terms of subsidization. Because of this approach, industry pioneers worked independently, competitively, and usually in a very fragmented manner. Now, however, the situation demands a coordinated approach within industry if common problems are to be solved.

International trade is one area in which government is working to assist Canadian farmers. Trade in fish products has not been subject to the same tariff restrictions as many other commodities, including agricultural products. Import/export tariff barriers are not significant considerations. Yet, there are a few non-tariff "irritants" relating to differences between Canada's fish health and product inspection regulations and those of our major client nation, the U.S. For example, current U.S. fish health regulations require that shipments of cultured fish imported to the U.S. be certified as being free of two fish pathogens — viral hemorrhagic septicemia virus and *Myxobolus cerebralis*. Neither of these organisms has been detected in Canadian salmon. Compliance with U.S.

certification requirements burden our industry with both inspection and bureaucratic costs that reach several hundred thousand dollars annually. As a result of pressure from the B.C. and Canadian governments, the U.S. regulations are being reviewed.

Similarly, to conduct interprovincial trade in dead or live fish, fish health certification is required by the Canadian Fish Health Protection Regulations. These regulations are also under review.

General Economic Trends

The success and further development of salmon farming in B.C. cannot be viewed in isolation from world production. Farmed salmon is now a major global supply source of fish products. Other countries have created specialized distribution systems for aquaculture seafood in order to capitalize on potential value. The industry must make a transition from being production-driven to being market-driven, and initiatives are being proposed in this area.

Cost of production for B.C. chinook is estimated at $6,300 to $7,000/t, including processing (see Table 4). This falls in the middle of the range for other producing areas, whose costs per tonne are estimated (DFO Report # 94, 1991) to be:

Scotland	$6,500 to $8,000
Norway	$5,500 to $9,000
Chile	$5,000
New Brunswick	$6,000

The ranges for Scotland and Norway reflect the fact that more northerly sites have higher costs of production. Chilean producers realize substantial savings in labour and feed costs, but transportation charges to the U.S. are higher. B.C.'s close proximity to U.S. markets gives producers a significant advantage in terms of lower transportation costs. Theoretically, this should act as a buffer against higher production costs. However, this advantage is greatly diminished when industry markets frozen farmed product.

Another large factor in the cost of production formula is inventory mortality rates. Fish mortality rates in B.C. initially exceeded those in other parts of the world and are slowly being brought under control. This is opposite to the situation in Norway and Scotland, where mortality rates are increasing yearly.

Both industry and government have learned much over the past five years. In general, there is a desire for continued participation and development, especially in the more isolated coastal communities of the Province. Economic diversification will be critical to the sustainability of these communities, given declines or fluctuations in the fisheries and forestry industries. Aquaculture is already helping—currently, salmon farming directly employs 1 200 people throughout the Province and indirect employment is estimated to be 3 500. Secondary industry sectors (e.g., processing, packaging, and transportation) are engaged in business with aquaculture operations year round.

Research and Development

The salmon farming industry requires major investments in research, development, and technology transfer. Research touches all aspects of industry development and specific issues tend to generate a wide range of short- and long-term research programs. In order to encourage cooperation and coordinate research, the B.C. Aquaculture Research and Development Council (BCARDC) has been established. This organization's mandate is to identify industry bottlenecks and resolve them by encouraging research funded by established research funding agencies such as the Science Council of B.C., the National Research Council, Industry, Science and Technology Canada, etc.

The members of the BCARDC represent all sectors of the aquaculture industry, B.C.'s universities and community colleges, and the Science Council of B.C. The Ministry of Agriculture, Fisheries and Food and the federal Department of Fisheries and Oceans have observer status at all meetings.

The BCARDC represents an important development in creating industry- and market-driven research and development. As pressures on industry competitiveness increase, directed R&D to solve key problems affecting industry's production costs become more important.

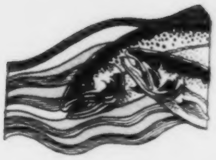
The salmon farming industry has identified four major problems facing the industry which require priority R&D effort. These four key problem areas are viewed as critical to the future competitiveness and viability of the industry:

- bacterial kidney disease
- furunculosis
- sea lice
- predators

These problems collectively result in annual losses to the industry in the magnitude of tens of millions of dollars.

In the future, every effort will have to be made to continue building the R&D linkages between industry, governments, and the universities and colleges so that ongoing partnerships in solving key industry problems are created.

Critical Factors for the Success of Salmon Farming



The salmon farming industry has reached an important plateau in its developmental history. Exceptional sectoral growth has been tempered recently by dynamic global market conditions, evolving production factors, competing demands for aquatic resources, and environmental considerations. British Columbia's salmon farmers must now survive the current rationalization process.

For the industry to succeed financially and build on its reputation as one of the world's leading producers, both industry and government must have a clear understanding of the critical factors affecting sustainable development and act appropriately.

Product Market

Historically, the industry may have been production oriented. However, since the downward trend in salmon prices, brought about by large increases in world supply, marketing issues have taken on a much greater importance.

In 1991, the B.C. Salmon Farmers Association successfully initiated a $3.2 million, five-year Market Development Program. The program will be jointly funded by industry, the Western Economic Diversification Office and the B.C. Trade and Development Corporation. The BCSFA has formed the B.C. Farmed Salmon Institute to implement the program.

The issues related to marketing are:

Product

Chinook and Atlantic salmon are the two primary species produced in B.C. The average dressed weight of farmed chinook salmon in 1990 was 2.13 kg, while Atlantics averaged 4.3 kg.

Increasing amounts of both wild and farmed salmon on world markets will result in continued depressed prices unless significant efforts are made to increase consumer demand.

To compete effectively with other seafood and protein products, salmon of consistent quality must be produced. Canada has disciplined and well regulated seafood inspection programs that do not exist to the same degree in the United States. Fisheries and Oceans Canada is developing a quality management program for seafood processors which sets specific criteria for using a "Canada Grade A" logo. This program should prove useful in promoting and enhancing the image of B.C. salmon.

The market place demands a consistent supply of fresh, high-quality product every week. However, production from the Province's farms is highly cyclical. In 1990, over 50% of B.C.'s farmed salmon was sold in less than five months, with 80% of the harvest being chinook with an average weight of 2.13 kilograms.

Different sized fish are needed for different market segments. There is a demand for fish suitable for fillets, steaks, banquet fish, and whole fish for retail sales.

"Consumer friendly" products in easy-to-use forms need to be developed if B.C. farmed salmon is to successfully compete with the abundance of other seafood and animal protein foods sold in value-added forms.

Consumers know little about B.C. and Canadian seafood quality-assurance initiatives, government seafood inspection programs and product safety requirements.

Price

Salmon is subject to global commodity pricing. Both farm and wild-harvest producers have little influence over pricing.

Inconsistent supply and lack of coordination between suppliers allow seafood buyers and distributors to bargain and influence the price, notably to the disadvantage of the B.C. producer. The industry is a price taker, rather than a price setter.

Distributors/wholesalers and retailers are the most powerful participants in the distribution channel. Clear evidence of this power was witnessed during the last two years when retailers failed to pass along to consumers substantial price reductions by processors and producers.

A dependency on export markets leaves the industry vulnerable to exchange-rate fluctuations, tariff and non-tariff barriers.

Place

In 1991, B.C. exported to the U.S. an estimated 11 500 t of farmed salmon, valued at more than $75 million. This has made B.C. the leading supplier of farmed salmon to the United States. The geographic proximity of Norway and Scotland to key European markets presents a disadvantage for B.C. producers wishing to sell there.

Japan, although a large importer of salmon, has its own salmon farming industry, which meets much of the country's domestic needs.

The American anti-dumping action against Norway in 1990 has resulted in a 26% duty on fresh, head-on Norwegian farmed salmon. This may force Norwegian suppliers to produce more value-added salmon products (including frozen salmon) which will not be subject to the countervailing duty.

The B.C. salmon farming industry is well positioned to exploit its close proximity to the large and growing U.S. market place.

Promotion

Traditionally, salmon is perceived by consumers as an expensive product, served on special occasions. This image is reinforced by higher prices relative to those of other protein sources.

Canada is significantly out-spent in generic promotion by all the major salmon producing countries. The State of Alaska alone spent over $6 million promoting its salmon products in 1989.

The potentially negative attitude of consumer advocate groups toward farming practices, environmental interactions, the use of antibiotics and other drugs, and the safety of seafood products due to pollution may represent problems for the industry.

To increase the demand for fresh salmon, consumers need more information, not only about the nutritional values of salmon, but also on easy methods of preparation that have consumer appeal. This would be enhanced by making product available in various 'kitchen ready' forms to simplify and shorten preparation.

At present, most promotion of fresh B.C. salmon is left to the retailer, the restaurateur, or the distributor and is not part of any overall strategy that has been developed and implemented by the producer, to achieve producer objectives.

Successful promotion will require coordination between key industry participants along with significant funding support in order to achieve long-term increased demand and expanded market share. Hence, the BCSFA's newly formed and co-funded B.C. Farmed Salmon Institute.

Production and Business Viability Factors

In the 1980s, a period when higher prices for the product were available in the marketplace, considerable investment was attracted to the industry. With the collapse of global salmon prices all farmers had to face the reality of dwindling, if not disappearing, profits from their operations. Salmon companies quickly realized that costs of production had to be reduced and farm efficiencies increased.

A broad range of interrelated issues make up the factors affecting production and business viability.

Research and Development

Losses to disease are still unacceptably high. Although BKD and vibrio are the primary causes of mortality at present, furunculosis and marine anemia are likely to develop as significant problems over the next few years.

Sea lice, a common marine parasite, is currently not a problem in B.C. In light of growing interest in Atlantic salmon culture, however, advance planning to combat this problem, if it arises, would be prudent.

Predator losses add significantly to a farmer's cost of production. Direct losses and the indirect effects of predatory attacks (e.g., increased stress and disease susceptibility) currently cost the industry millions of dollars annually. Both simple as well as highly technical methods of deterrence have failed in most instances, particularly against seals. The control and management of predation must be devised on a regional basis, using methods appropriate for controlling each specific predator species. Predator control is an issue that is under study, but assistance in this regard is necessary.

Competitiveness

Aquaculture needs a system to gauge performance in order to maximize competitiveness. The C.A.S.H. Program (Cooperative Assessment of Salmonid Health) and the federal Inter-Firm Comparison Study are the types of activity needed to record vital information. Industry information bases would be developed on species growth and development and production results and costs, relative to industry standards.

In an industry where there is no product differentiation and there is greater supply than demand, the lowest-cost producer will endure.

Labour costs are high in British Columbia when compared to other countries such as Chile. While feed costs are also high, strong competition in that sector may help to keep prices in line.

Stock inventory verification is fundamental to all agri-business. Even though salmon farmers now have much better control over fish inventory, some problems still persist. Improved inventory determination methods would benefit farmers by reducing handling losses, enabling them to adopt more efficient feeding practices, and ensuring accurate harvest planning. Banks and other conventional lenders are generally not satisfied with the degree of accuracy attained by existing inventory verification methods. This has proven a major obstacle for farmers wishing to use live fish as an asset against which financing may be obtained.

Mechanization and the application of improved husbandry techniques will help reduce costs, but the financing of such initiatives is difficult. Also, many firms are experiencing a shortage of working capital with which to enhance their operations.

Government imposed costs, such as taxes and fees, must be re-examined to ensure that they do not unfairly burden aquaculturists, particularly when compared to other more traditional farming activities in B.C. and the industry's competitors abroad.

Environment

Algae blooms (phytoplankton) continue to be a problem in several areas, and specifically along the Sunshine Coast. Along the West and North Coasts of Vancouver Island both of the common algae species known to be toxic to salmonids have been detected, and some farms have experienced high mortalities due to algae blooms. Although avoidance is the best solution, this may not be possible. Simple mitigation measures are available, but more work is needed to reduce losses.

The recovery, handling, and disposal of fish that die during the production cycle is an ongoing problem and an economic drain on fish farm resources. While it has been proposed that this waste material has potential as a by-product resource for waste utilization, few cost-effective uses have been found. Mortalities remain a liability and pose a disposal problem for farmers. Costs to remove the material to points where it can be used in a secondary process, such as compost or liquid fertilizer production, must still be borne by the farmer.

Leading the way in development and extension of mort and fish waste utilization technology is the Pacific Bio-Waste Recovery Society. This non-profit society was created in 1991 by the University of British Columbia, Mount Washington Community Futures Committee, MAFF, and industry members from the fish farming and processing sectors. The society is creating an environmentally friendly and cost-efficient fish silage and offal composting facility at Oyster River on Vancouver Island. The society's aim is to refine its composting expertise and make it available to others throughout the province.

Government Regulatory Environment

The unavailability of therapeutic compounds in Canada for the salmon farming industry has reached critical proportions. The industry has access to only two antibiotic compounds to treat various fish diseases. This is in contrast to our international competitors (such as Norway, Scotland and Chile) who have access to a much broader selection of compounds.

The industry urgently requires access to therapeutics effective in the treatment of furunculosis in Atlantic salmon. Without access to these compounds, the economics of Atlantic salmon farming change dramatically and will seriously harm Atlantic salmon producing companies, which now constitute about half of the industry.

The regulatory hurdles blocking access to these compounds are considerable. The industry requires advocacy from federal government agencies to obtain these compounds under the Emergency Drug Release Program.

Lake net-pen rearing of Atlantic and S1 chinook smolts can potentially supply large quantities of high quality smolts to the industry while realizing substantial savings in production costs. In order to engage in lake rearing on any significant scale, however, environmental and social-economic issues need to be realistically addressed.

Worker safety is an issue in any industry. Definitions of safe work practices (particularly diving practices) and guidelines governing working conditions on salmon farms need to be clarified. Industry has adopted some voluntary safety guidelines, but mandated practices are not in existence. The Farm and Ranch Safety Agency has been formed by the B.C. Federation of Agriculture to develop and encourage use of safe practices in agriculture through voluntary adherence to standards. This agency should work closely with the BCSFA and MAFF to ensure that work practices in salmon farming are defined and adhered to.

Financing

Establishing a salmon farm requires considerable capital investment. Due to the long production cycle, substantial inputs of operating capital are required. Securing this financing has proven to be extremely difficult. Equity markets are all but inaccessible at present, due to a number of high-profile corporate failures. Government financial assistance programs are virtually non-existent for aquaculture. Also, most conventional lenders are reluctant to finance all but the most financially secure farming companies. Ongoing problems exist in valuating live-fish inventories to the satisfaction of bankers.

Role of Government

The Federal Government has primary jurisdiction in regard to coastal waters and activities conducted therein. The Provincial government has primary jurisdiction in regard to foreshore property rights, fresh-water access, commerce, and farming, to name a few. Local governments are responsible for zoning by-laws. There is often uncertainty as to the limits of these sometimes concurrent, or competitive jurisdictions. On some issues, the different levels of government are in agreement. On other issues this fact is not always clear. Even though there may be agreement at certain administrative levels of government, inconsistency and conflict can still occur at the operating level.

The salmon farming industry operates in this uncertain environment. The lack of clarity on issues and time taken to resolve new situations and engage in a negotiation and consultation process with the various governmental interests is a direct cost to industry.

The role of government and the manner in which legislation is devised, regulations are enforced, and advocacy is exercised are factors of critical importance to industry and the public.

Regulatory Reality

The need for regulations governing activities which utilize public resources is recognized. Also, the growing of food products needs to be done in a regulated manner that generates confidence in the value and quality of the products for human consumption. Key to this is the development and application of rational, progressive regulations.

The development of regulations affecting the industry has not been a well-managed process. In most cases, existing legislation and regulations governing the wild fishery were amended to encompass aquaculture. Not enough emphasis or commitment was made to accept aquaculture as agriculture.

There is a perception within industry that regulations have often been devised without adequate industry consultation. There is a need for improved two-way communication between government and representatives from aquaculture and other industry sectors. Effective consultative mechanisms are essential if progress is to be achieved on emerging issues, the application of new technology, and other developments that have an impact on the industry's viability.

Adequacy of Advocacy

In British Columbia, the Ministry of Agriculture, Fisheries and Food has regulatory responsibility for the salmon farming industry and functions in an advocacy role for the industry, particularly in intra and intergovernmental liaisons. MAFF does have input into environmental considerations and other governmental initiatives that could have an impact on the salmon farming industry.

However, is MAFF capable of exercising the degree of influence needed to ensure aquaculture's interests are protected? The influence of other advocate ministries, such as Ministry of Forests, have a more significant political voice which could subvert the interests of the salmon farmers. It is recognized that there are limitations to the advocacy role of MAFF. On some issues the industry may well be better served to present a separate position and use different means, depending upon the nature of the issue. The B.C. Salmon Farmers Association or the Canadian Aquaculture Producers Council are other vehicles for this type of activity.

The Department of Fisheries and Oceans is aquaculture's federal advocate agency. However, DFO is also the advocate agency for the commercial fishery. The interests of the two industry groups have often been perceived by DFO to be in conflict. Due to the agency's long-term relationship with the commercial fishery, DFO's ability to act as aquaculture advocate has generally been constrained over the years. The department must make a concerted effort to close the gap between its two seafood-producing client groups—farmers and fishermen.

Industry linkages to Agriculture Canada are surprisingly weak considering the agri-business nature of salmon farming. Aquaculture as a whole would benefit from greater access to federal agricultural development programs and expertise.

Services to Industry

An important issue for the industry is the public perception of the quality of farmed salmon. It is necessary that a comprehensive inspection and testing program be efficiently carried out to ensure public confidence in the products and that the consumer public be made aware of these initiatives. The industry is somewhat vulnerable in regard to this federal issue.

The success of any agricultural livestock enterprise is tied to the development of broodstock genetics programs and the assessment of resulting breeding lines for desirable production characteristics. The same is true for aquaculture. To gain market share, the industry needs to diversify into other species or strains that will broaden harvest windows and influence product size. Salmon farmers currently have limited access to both Pacific and Atlantic salmonid strains.

A major chinook salmon strain evaluation program is currently nearing completion. Twenty stocks are being evaluated. Some are quite clearly poor choices for farming, while others show promise. This information will provide the basis for future chinook salmon breeding programs.

Importation of Atlantic salmon eggs began in 1985, peaked at 2.7 million in 1986, and totalled 7 million when imports were halted in 1989. Some of the imported stocks have performed poorly in B.C., either because of strain characteristics, unknown genetic bottlenecks in the imported strain, or because of possible inbreeding since import.

The Federal government has jurisdiction over access and introduction of aquatic species into the Province. Several companies in the industry have requested approval to bring in eggs of different strains to enhance the genetic base of Atlantic salmon in B.C. These requests were resisted by DFO and the Ministry of the Environment in 1989, but approval was finally given to a one-time importation of 350 000 St. John River strain eggs in 1991.

Environmental

We live in an age of heightened awareness of environmental and personal health. While opponents of the industry have used spurious arguments in their overall attack on development of aquaculture, some consumers have expressed interest in knowing more about the product they are consuming, the environment in which it is raised, and whether the production practice is overly consumptive of resources or environmentally unsound.

Salmon farming requires clean water to grow its product. Many coastal areas in other parts of the world are not suited to salmon farming because of industrial pollution, unsuitable water temperatures, or physical configuration of the coastline. While not all of British Columbia's coastline is optimal for salmon culture, there is more than sufficient area to establish and sustain a productive salmon farming industry.

Of primary concern is the pollution of coastal waters by other industrial users. Pulp mill discharge, ballast water and waste from ships, and municipal sewage are all considered to be the major sources of pollution in coastal waters.

There are, in some cases, regulations governing these categories of pollution, but often the regulations are not enforced sufficiently to stop the pollution or bring about meaningful solutions. There appears to be a strengthening of the political will to undertake enforcement activities with enough commitment to achieve the necessary results. This resolve must be reinforced.

Periodic high temperatures and phytoplankton blooms have precluded some coastal areas as viable culture sites. Conflict with other users, such as recreationalists, is also a problem. The industry is making a move to more remote areas with greater oceanic influence in order to escape these problems. The development of transportation infrastructures in outlying regions is key to this relocation.

Salmon farms are contiguous with waters containing wild fish and their attendant diseases. In conventional agriculture, attempting to isolate production animals from disease organisms (as is done by poultry farmers) is clearly a sound strategy. This is impossible to undertake in salmon farming, so disease must be controlled through preventive measures such as vaccination, stress minimization and through appropriate therapy. BKD and vibriosis presently account for most of the disease-related mortality on B.C. farms. Furunculosis and marine anemia may become more of a problem in the future. Periodic disease surveys, in addition to more routine disease data collection, will give the industry indications of disease prevalence, trends, and significance.

Salmon farmers are currently dependent on antibiotics to combat diseases. Although dependence may lessen with production of new and more effective vaccines, domestication of fish, and improved husbandry practices, farmers will continue to need access to antibiotics to treat their fish because disease organisms are endemic in wild populations. Antibiotics must be used within a framework which considers the health of the farm worker, the animal, the environment, and the consumer. Several steps have been taken to develop this framework:

- the Canadian Fish Health Protection Regulations
- the Emergency Drug Release Program
- development of antibiotic screening methodologies and testing programs
- the introduction of drug clearance regulations.

Farmers require expanded access to antibiotics on a more routine basis, as well as a wider range of antibiotics proven effective against specific diseases. Because the fish farming industry is small, it has received little attention to date from pharmaceutical manufacturers. This relative lack of research and development could prove a liability if fish diseases become a greater problem for salmon farmers.

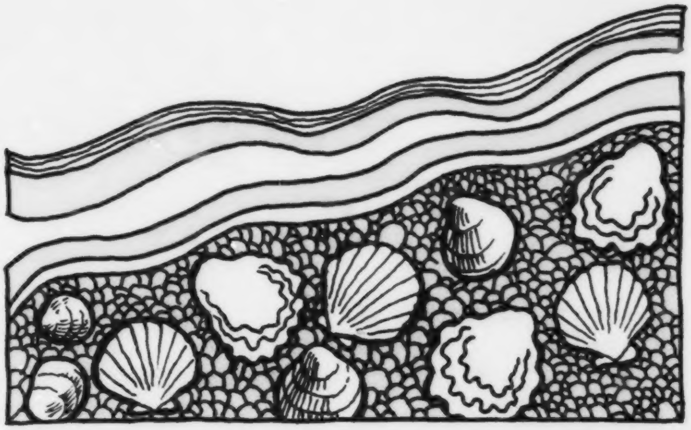
Atlantic salmon appear particularly susceptible to sea lice. Consequently, as the industry focusses on this species, the problems created by sea lice can be expected to increase. In addition, caprellids (tiny crustaceans that inhabit fouled netting) have been known to infest B.C. farmed salmon. In Europe, sea lice are treated with an organophosphate (and caprellids would likely be treated in the same manner). This treatment has caused much controversy because of concerns about environmental damage and about dangers to workers applying the treatments. Continued investigation into ways of dealing with sea lice (and caprellids) along with advance planning may enable the industry to minimize anticipated difficulties.

Predation by a number of wild animals, particularly seals and otters, inflicts significant losses on numerous B.C. salmon farms. Over the years, farmers have experimented with different methods and varied technologies in attempts to resolve the problem. Success has been inconsistent, at best. A review of options for dealing with predation (including a review of federal regulations dealing with control of predatory species) could result in development of better control strategies.

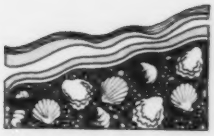
Disposal of dead fish, or mortalities (morts), from salmon farms has been an ongoing nuisance and, periodically, a major problem for salmon farmers. Few options exist for mort disposal directly at the farm site. At the request of industry, MAFF has initiated a major new program aimed at resolving the problem of mort disposal. The program is designed to focus on the potential for practical, on-farm mort ensiling and economical waste utilization. However, implementation costs are borne by farmers.

Animal welfare issues with respect to raising fish under current rearing conditions are expected to be minor over the next few years. The industry can point to low rearing densities, high environmental quality, stress minimization, etc. as being universal husbandry goals. More contentious will be the industry's need to control nuisance, predatory animals.

Shellfish



Development Objectives for the Shellfish Industry



The overall goal of virtually any business in a free-market economy is long-term success. Success is most commonly linked to financial viability, sustainability and, ultimately, bottom-line profitability. British Columbia's shellfish farming industry is no exception.

Sustainability will only be achieved, however, if action is taken by both industry and government to address certain fundamental issues arising from the fact that (1) the industry resides in and is dependent upon an environment that is shared with other industries and the general public, and (2) shellfish farmers are involved in a dynamic and growing marketplace that offers new challenges and opportunities.

In today's milieu of environmentally conscious sustainablity, there are few industries that score higher than shellfish farming when one combines the attributes of job generation, revenue growth, and environmental responsibility.

The following strategic objectives, which reflect industry priorities, have been identified to address the issues affecting shellfish culture.

Objective 1: to improve and protect the marine environment

- ☐ More adequate and consistent testing of coastal waters for pollutants and toxins are needed.
- ☐ Firm but fair enforcement of government rules and regulations pertaining to pollution issues is essential (violators must be dealt with in a manner that results in rapid solutions to pollution problems and, ideally, the restoration of the affected marine environment).

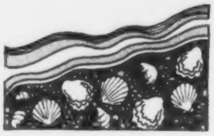
Objective 2: to optimize the use of Crown lands made available for shellfish culture and improve the efficiency of the industry at all levels

- Fair and consistent enforcement of the regulations governing the diligent use of Crown lands is essential (to be effective, enforcement must be of a nature that results in action leading to increased production from leases in question, not the removal of those areas from the shellfish farmland base).
- Changes to the policies regarding the acquisition of new aquatic "farmland" tenures are needed.
- The industry must make every reasonable effort to reduce the costs of production (government transference to industry of new technologies and current research findings that are relevant to the industry's needs would facilitate this process).

Objective 3: to create an effective mechanism to facilitate communication between the industry and government

- The conflicting and competing interests that exist both within and outside of the industry represent an obstacle to communication between shellfish farmers and the government; a more consolidated approach is needed.
- Ongoing industry participation is required in the development of policies and regulations that affect the growth and viability of the industry.

Pacific Oyster: Industry Profile



At present, the Pacific oyster is the only cultured shellfish species of economic significance in British Columbia. This non-indigenous species was first brought to B.C. from Washington State for recreational purposes at the turn of the century. Importation of seed for culture started in 1912, and by the 1920s large shipments of seed oysters were being imported from Japan. Over a period of years, the seed was spread at many locations along our coast. Eventually, extensive "wild" populations emerged. In 1948, a highly prolific natural-breeding population was discovered in Pendrell Sound. This provided a fairly reliable seed supply for the small oyster industry until the mid 1980s. Producers now rely mainly on commercial hatchery spat and seed stock.

There were 401 oyster culture tenures issued to 282 companies in December, 1991. Another 84 applications were pending. The industry occupies 1 523 hectares of Crown aquatic land, divided almost equally between intertidal and deep water tenures. The sites are distributed around Vancouver Island and the Sunshine Coast, but are primarily located in the Strait of Georgia and secondarily on the west coast of Vancouver Island. Smaller numbers of producers exist on or near the northeast and south coasts of Vancouver Island. The greatest production continues to be achieved in Baynes Sound, on the Island's east coast.

There are currently 55 federally registered and provincially licensed shellfish processors in B.C. Most of these plants also have FDA (U.S.) certification and can export product to the U.S. All plants ship in-shell bivalves, while shucked oysters are produced at only 20 facilities. These shucking operations are for the most part located along the Strait of Georgia area.

The B.C. Shellfish Growers Association (formerly the B.C. Oyster Growers Association) has been representing the interests of the shellfish industry for over 40 years, making it the oldest aquaculture association in Canada. With the recent inclusion of the Clam Farmers Association of B.C., the BCSGA currently represents over 80% of all shellfish production in the Province. While only 30% of all oyster growers are members, the BCSGA has the support of all the most successful farmers in the industry. The Aquaculture Association of B.C. and four regional associations also represent the interests of growers, though to a lesser extent. In the past, the lack of unified representation has hindered lobbying and industry development efforts. Recognizing the need to strengthen the industry's voice in B.C., several of the smaller associations will most likely create formal linkages with the BCSGA in 1992.

Production Overview

Most of B.C.'s oyster seed production is done at remote-setting facilities on individual farm sites. Farmers induce hatchery-produced eyed larvae to set on spat collection material (cultch) in insulated tanks using remote-setting techniques. This well documented procedure has helped growers alleviate the uncertainty of obtaining commercially viable spatfall from nature and has superseded the collection of seed from coastal spawning areas. The widespread adoption of remote-setting technology should protect the industry from seed supply shortages which constrained sector development in the early 1980s.

The vast majority of eyed oyster larvae used at remote-setting sites in the Province originates from three U.S. hatcheries. It is interesting to note that Washington State, a recognized world leader in shellfish technology, started hatchery system development with assistance from B.C. Our innovative technology was exported for commercialization several years ago because of lack of local interest and funding. However, B.C. now has two larvae-producing hatcheries at Baynes Sound and Lasqueti Island.

Although not all oyster growers do their own remote setting on site, farmers often work together to utilize equipment cooperatively, thus gaining some economies of scale. For those farmers wanting to purchase single seed from a nursery facility, there are two suppliers in B.C. and several in Washington State and California.

B.C. growers produce oysters for in-shell ("half-shell") and/or shucked-meat products. Both types of product may be produced on intertidal (bottom) or deep water (off-bottom) tenures. Bottom culture typically involves distributing seeded oyster shells on the beach between the 0.5 m and 2.5 m tidal levels. Off-bottom production involves suspending seeded shells or plastic tubes or trays of oysters from rafts or floating longlines. Off-bottom culture provides faster growth rates and higher unit area production, but requires a higher investment of fixed assets for culture and harvesting.

Over 98% of B.C.'s oyster production is derived from aquaculture. Commercial harvest of wild oyster stocks contributed only 67 t of product in 1989, at a value of $29,031 (see Table 6).

TABLE 6: B.C. Oyster Culture Production and Farm Gate Value

	1988		1989		1990	
	Produced	**Value ($)**	**Produced**	**Value ($)**	**Produced**	**Value ($)**
Shucked Meat (U.S. gallons)	86 564	1 097 628	85 984	1 157 395	100 811	1 408 922
Half-Shell (dozens)	639 841	1 524 320	715 663	1 751 590	751 786	1 844 808
Shell Stock (pounds)	132 900	40 501	—	—	—	—
TOTAL CULTURE (converted t)	**3 576**	**2 662 449**	**3 654**	**2 908 985**	**4 106**	**3 253 730**
Wild Harvest (t)	126	63 066	67	29 031	n/a	n/a

While the industry trend appears to indicate an increasing amount of cultured product being processed as shucked meat, the majority of farmers still produce half-shell product. Preliminary figures show an increase in shucked-meat production of 17% in 1990, with eight companies accounting for 74% of the industry's total output. This contrasts with only a 5% increase in half-shell oyster production from a broader farm base (top seven companies only account for 37% of total dozens).

The Province's oyster production has historically been low when compared to that of other world producers. Since the early 1980s, however, interest in new husbandry and seed production technologies has created steady growth within the industry. B.C. is now well-positioned to significantly increase its yearly oyster production.

Harvesting bottom-cultured oysters is done by hand only. Harvest of oysters produced by suspended off-bottom culture is facilitated by vessels equipped with booms and winches to lift culture gear and product above the sea surface. Depending on growth rates and the desired size of the oyster, the production cycle is between two and five years.

Generally speaking, oyster production in B.C. is held back by two major limitations on the aquatic resource base:

- Nearly 40% to 50% of acreage tenured for shellfish culture is underutilized and not attaining reasonable levels of production. This situation can be attributed to poor or inadequate husbandry practices and a reluctance by some farmers to embrace new culture technology.
- The industry must compete for intertidal foreshore with the wild fisheries, even though farming is viewed by most parties to be the preferred form of land and resource utilization. Currently, DFO and MELP policies impede any tenured application for new culture ground, usually citing the possible loss of wild habitat. This effectively blocks any new expansion of the shellfish production base in B.C.

Market Profile

The pricing of shucked and half-shell oysters is partially regulated by the B.C. Oyster Marketing Board. Minimum prices at the wholesale level are set for oysters produced and sold within B.C. These prices do not extend to international exports, imports, or farm gate and retail sales.

In 1985, approximately 84% of shucked production and 86% of in-shell production was for domestic markets, with over 75% going to the restaurant trade. In 1989, more than 50% of in-shell product was sold outside of Canada, with most destined for U.S. markets. Canada imports approximately $6 million worth of canned and smoked oyster products per year.

Virtually all oysters are retail marketed fresh in-shell or as shucked meat in 225 gram or larger containers. A few companies have attempted to develop value-added product forms, but these have not made a significant impact on the market.

Seafood consumers are highly sensitive to negative reports about product safety, especially reports related to pollution or contamination of growing waters. The sharp and widespread decline in shellfish sales following the domoic acid contamination of P.E.I. shellfish and dioxin contamination of shellfish near B.C. pulp mills clearly demonstrate the negative impacts on market demand which can result.

Although consumer sensitivity over fecal contamination and paralytic shellfish poisoning (PSP) is not as acute, general concerns do exist. In Canada these items are conservatively monitored and regulated by Environment Canada EPS and by DFO Fish Inspection, respectively, to ensure that shellfish are not harvested and marketed from contaminated waters. In addition, the B.C. Ministry of Health inspects seafood retail outlets for compliance with sanitation regulations.

Consumer confidence in shellfish products and demand for those items could be enhanced through effective educational and promotional campaigns. Many consumers are not aware of how to judge the quality of shellfish or of simple ways to prepare it. This results in a reluctance to try fresh shellfish products at home.

Prospects for expanded export markets, primarily to the U.S., are good. Oyster production from the east coast of the U.S. and from the Gulf of Mexico is falling due to disease and water-quality problems. The primary challenge for Canadian producers wishing to target the U.S. market is economical production of a shucked-oyster product considerably smaller than that currently produced in B.C. The U.S. market wants a 140+ count per U.S. gallon, as was usual for the smaller American oyster. Our industry currently produces Pacific oysters with an 80-120 count per U.S. gallon. While wholesale prices for smaller oysters are higher and incurred farm production costs per harvest unit lower due to the reduced growing time, increased shucking costs are significant. It is uncertain how many B.C. producers will prove successful in targeting this American market. Further marketing and processing studies to develop this market are warranted.

When it comes to producing small, frozen oysters used for secondary processing and for canned smoked oysters, B.C. producers cannot compete successfully with Asian producers. Asian production and processing labour costs are markedly lower than those in Canada.

Due to fluctuating levels of production, small independent producers have difficulties sustaining markets. Coordinated or cooperative seed procurement and marketing efforts could help to solve this problem. Several companies have already established such cooperative agreements and proven them to be beneficial for all parties concerned. Attempts to expand this trend have recently been undertaken by the Sunshine Coast Aquaculture Association, the Barkley Sound Growers Association, and the Active Malaspina Mariculture Association.

General Economic Trends

The oyster industry is in a growth phase. Production in the near future can be estimated from information on seed production and the 2-5 year production cycle. In 1990, over 9 350 000 seed singles were produced by the industry. The two cultch types used are 2 m long plastic tubes and oyster shell from shucking plants. In 1990, approximately 142 000 tubes and 78 000 bags of shell were used in seed production. Each bag contains at least 100 shells (i.e., over 12 million shells were used to collect seed). Production of market-sized oysters can be conservatively estimated at 5 gal./1000 singles, 0.5 gal./tube, and 2 gal./bag of seed.

Purchased seed mainly originates from the U.S. In 1990, nearly 10 million cultchless seed oysters were purchased.

Production and sales have increased steadily from 2 800 t in 1986 to 4 106 t in 1990. It is estimated that production in 1991 will be over 4 500 t.

With an increase in the number of growers, adoption of more intensive culture techniques, and enforcement of reasonable production policies, continued production increases can be expected. Assuming continued seed production and purchases at the 1990 rate, there could be a sustained annual production of about 295 000 gallons or 7 000 t per annum by the mid 1990s. Many of the new growers are using off-bottom culture techniques which require more capital initially but utilize otherwise unproductive sites. Expansion of beach culture is also restricted by government in that it is virtually impossible to obtain new intertidal grow-out leases. Of the 75 applications for oyster culture tenures currently under review, the majority are expected to utilize off-bottom culture technology.

Research and Development

Until the 1980s, the B.C. oyster industry was slow to adopt new technology. At that point, many new growers began to culture oysters from suspended systems. Research conducted by MAFF and industry members resulted in improved and standardized procedures for remote setting of oyster larvae, making this technique a relatively reliable means for growers to obtain seed suitable for their culture systems. Application of remote-setting technology has been the major factor in the recent growth of the B.C. oyster industry.

Future research and development is expected to centre on five primary themes:

- food quality and product safety issues (e.g., improved PSP testing, depuration techniques, pollution control)
- oyster hatchery and nursery system development in the Province (intended to lessen dependency on foreign supply)
- genetic improvement of oyster broodstock (to increase disease resistance and growth rates for culture in B.C.)
- polyculture possibilities—cultivation of multiple species (e.g., clams and oysters on the same farm) and of diverse oyster species (e.g., Kumomoto, European flat oyster)
- mechanical harvesting technology (particularly for off-bottom oyster and beach clam production).

Critical Factors for the Success of Oyster Farming

For oyster farming to continue to grow and achieve long-term financial success, industry and government have both individual and cooperative roles in focusing on preserving the integrity of the environment; addressing land use issue; developing marketing strategies; establishing effective communications; and, defining the role of the government.

While each factor is dealt with individually, industry and government must recognize and address the dynamic interdependence between the condition of the aquatic environment and each critical factor for success.

The Environment

The industry is completely dependent upon the quality of the coastal water in which farming occurs. Without a clean environment, the shellfish industry cannot survive.

As well as having profound and long-term impacts on the natural fishery and other uses of the environment, good water quality, free of contaminants, is essential for public health and for the viability of the B.C. oyster industry. Every effort should be made to correct the environmental mistakes of the past and to plan wisely for future population growth in British Columbia's coastal areas to ensure that such growth does not erode water quality.

The two key areas to address have been identified as pollution and water quality.

Pollution

Water pollution from sewage and industrial effluent poses a major environmental threat to oyster culture in the Strait of Georgia. Closures of productive shellfish areas due to sewage pollution are on the increase. Over 4 000 ha of highly suitable intertidal area could be reclaimed for shellfish culture if adequate sewage treatment were provided.

Although present regulations intended to diminish and eliminate pollution exist, they are not being enforced. Pollution is allowed to continue and the risks to the oyster farms are increasing. Pollution not only affects the land in use by the leaseholders in the shellfish industry, it also affects all of the shoreline and beaches that are held in trust by the Province for the benefit of all British Columbians.

The major sources of marine pollution are:

Pulp Mills

Mills have been dumping effluent containing known harmful substances into the coastal waters for years, yet not enough is being done to determine the intensity and scope of the problem. There is a prevalent view that the Government is unwilling to come to terms with the pulp mill problem, even though it is essential that the dimensions of the pollution be identified and that information made available to the public. Stronger efforts are required to ensure that remedial action is taken where and when it is warranted. The recent announcement by the B.C. government that all of the Province's pulp mills must be completely organochlorine free by the year 2002 is very encouraging. Enforcement of such progressive regulations will mean the opening of closed areas for culture and wild harvest. However, adding to the challenge will be the problem of fragmented levels of responsibilities, not only between different agencies of the Provincial government, but also with the Federal government.

In 1990, industrial pollution effluent containing dioxins and furans resulted in closures of oyster farms in the vicinity of several pulp mills in the Strait of Georgia area. Continued efforts to eliminate the release of industrial and domestic pollutants are critical to the long-term success of the B.C. oyster industry. In the interim, current anti-polluting laws **must be** enforced.

Sewage

Cities and municipalities, as well as private firms, have been dumping increasing volumes of raw effluent into coastal waters.

Boats

Large and small vessels ply the B.C. coast in increasing numbers. Not only do many dump raw effluent into these waters, some vessels from foreign ports dump effluent and ballast that can contain unwanted organisms and diseases which could have serious consequences. Regulation and control of this situation is required.

Logging

Wide-spread clear-cut logging and associated road building through B.C.'s coastal forests have changed run-off patterns and seriously damaged creeks. This has caused severe siltation problems for shellfish operations downstream of these logging shows and deposited other debris on farm leases.

In addition, increases in volatile fecal coliform counts (predominantly *klebsiella*) result from decomposing cellulose in logging slashes. Without proper acknowledgment, research into aspects of the bacteria (e.g., consequences of human ingestion) and on-site testing capabilities, growers face the possibility of costly product rejection at the processing level.

Naturally, many health questions arise due to pollution: Are shellfish safe to consume? Is an area safe today, still safe tomorrow? These questions also pose a real threat to the marketability of B.C. fish and shellfish products. Consumer sensitivity to the quality and safety of seafood products will be increasingly difficult to reverse.

Water Quality Testing

The shellfish industry is **not** a contributor to the water pollution problem—it is a victim of it. Like the tried and true canary as an early warning system for deadly gases in coal mines, the shellfish industry, because of its sensitivity to water quality, serves as an early-warning system for the degradation of the aquatic environment.

There is a perception that the Government is reluctant to deal with the water-quality issue. At present, testing is not being done on a uniform and consistent basis. However, public confidence in the existence of a clean environment is critical to the development of the market for shellfish farming products.

Because clean water is essential for the industry to exist and prosper, the quality of water conditions of all key coastal areas should be monitored on a regular basis and the results of these tests should be made available to the public. Adequate testing for contaminants in both the water and in the product is a requirement, and not only for the obvious health issues. If the industry cannot promote its products with confidence as having come from one of the safest natural environments in the world, important industry opportunities will be lost.

Increased and improved testing for PSP along our coast could allow smaller, more regionally specific closures than are currently imposed, while still maintaining a healthy margin for public safety. This may make it possible for some growers to market product if their local sites are clean, despite elevated levels in another part of the large management area. At present, DFO Fish Inspection tends to close the large fisheries statistical areas to all shellfish harvesting (wild commercial, aquacultural, and recreational), based on monitoring results from selected stations, rather than on the basis of site-specific testing.

Provincial and federal government agencies have an important role in terms of maintaining and augmenting the area available for oyster culture. This is being achieved through habitat review policies that not only promote responsible growth of the sector, but control the encroachment of incompatible coastal activities into aquacultural habitat areas. In particular, the Ministry of Agriculture, Fisheries and Food and the Ministry of Environment, Lands and Parks must strive to promote industry growth by reviewing applications for new tenures and by ensuring that new and existing tenures are diligently used.

Farmland Utilization

Issues dealing with the availability and utilization of Crown land for the purposes of shellfish culture are key factors in determining the ability of the industry to meet market opportunities.

Diligent Utilization

There are over 400 existing intertidal and deep-water leases covering 1 523 hectares of Crown aquatic lands committed for the purpose of shellfish farming, primarily oyster culture.

Strict government regulations on the diligent use of Crown land exist, but these regulations have not been enforced. Consequently, much of the land (40-50%) committed for the purposes of oyster farming is not being brought into full production. This condition has a direct relationship to the level of production that can be achieved and the rate at which the industry can grow.

The problem of unsatisfactory land utilization is known and understood by both industry and government officials. While surveys of the situation have been conducted, little follow-up action has been taken. It is estimated that existing leases are capable of double or triple the level of production currently achieved by the industry. Lease holders need a clear message from government that they must perform as farmers or the tenured Crown land will be made available to more diligent growers.

Land is a limited resource. It must be used wisely.

New Farmland

Even though there are underutilized leases, this problem should not obscure the fact that in some areas existing shellfish tenures are well developed and additional leases are needed. The policies regarding the granting of new farm tenures must be applied in light of the needs and capabilities of each individual coastal area or region.

Product Market

It is important for any producer to ensure that there is a strong and growing market for the product. A fundamental analysis of marketing strategies identifies the following critical factors:

Product

The importance of the environmental issue cannot be over emphasized. It is a critical element in the long-term success of marketing B.C. seafood products.

Freshness and quality are the cornerstones of successful fresh seafood marketing, but safety concerns due to possible contamination from fecal and industrial pollution, as well as toxic algal risks, represent a potential constraint to industry growth. To increase public confidence and product demand, it is important that thorough and consistent testing of the product is undertaken to eliminate the perception of health risks.

The industry must take advantage of its proximity to a large market along the west coast of Canada and the U.S., emphasizing the freshness and quality of B.C. products.

Opportunities for most value-added products in domestic and export markets are not presently known. However, a ready market exists in the Pacific Rim for individually quick frozen (IQF) oysters in the shell.

The industry requires cooperative marketing strategies and research into these kinds of market opportunities and production methodologies that are needed to ensure the viability of any new initiative.

Domestic industry production costs are generally recognized to be higher than U.S. and Asian production costs, due largely to the higher cost of labour. However, the B.C. shellfish industry can compensate for this problem with better application of technology and habitat utilization.

In the long term, continued growth and economic viability of the provincial oyster industry will be closely tied to success in the export marketplace, (i.e., U.S. and Pacific Rim.) But given the current size and structure of the industry, these activities will be slow to occur in the immediate future.

Price

While the B.C. Oyster Marketing Board sets wholesale prices for oysters in the Province, it has to date been ineffective in developing markets.

The downward price pressure in Canada from U.S. competition restricts the profitability of the B.C. industry. In addition, different standards exist in Canada and the United States regarding shelf life of the product. A 21-day shelf life for

U.S. products is allowed, while the Canadian regulation limits this to 14 days. This restriction creates a significant cost to the Canadian shipper, which in turn is extended to the consumer.

To compete, B.C. must ensure high quality and consistent supply.

Exchange rate fluctuations substantially affect export market opportunities.

Place

Adequate information with respect to the distribution of oysters to the final consumer (e.g., retail vs. food service, domestic vs. export market) is not available.

Market data for various geographic areas (e.g., historical sales volumes by product type, trends, pricing, sizing, grade standards, regulations and inspection regimens, and competitive promotional activity) is also not currently available.

Declining production on the east coast of the U.S. and growth in the already large market in Japan represent market opportunities for the B.C. industry, if it can respond with increased production in a timely fashion.

Promotion

While data on oyster consumption does not exist, consumers have serious concerns regarding shellfish product safety, particularly with oysters from U.S. production areas. A safety or quality problem with an east coast product can have an immediate effect on the sale of B.C. products, even in the B.C. market. However, consumers are beginning to differentiate between east and west coast supply, and current perception is that the western product is safer.

With proper regulation, the B.C. fish products industry, and the shellfish sector in particular, has the opportunity to promote product from the "cleanest waters in the world." The ability to do this will be of increasing importance in the future. However, the shellfish industry alone is not large enough to afford the cost of undertaking an aggressive marketing program without financial assistance.

Communication

Historically, many people were attracted to shellfish farming because of quality-of-life considerations. Today, it is apparent that a strong sense of individualism and entrepreneurial spirit still exists in the industry. While these qualities may have contributed to the growth of the industry to its present state, they can also work against the development of the industry when they inhibit the ability to speak in a unified manner.

To be truly effective, the drive for one representative voice must come from within industry. Successful lobby efforts and internal coordination of communications to government, the public, and special interest groups are essential for the continued success of the industry.

Two-way dialogue between industry representatives and government, especially regarding development issues, regulations, and research priorities, will assist the industry in its competition with other interests.

The Role of Government

The magnitude of some issues affecting the shellfish industry is very great and of significant consequence to several sectors of our economy and the public at large. With this in mind, governments must achieve an equitable balance between the advocacy and regulatory roles.

Advocacy Role

Although the shellfish industry is small and capable of varying degrees of consensus on different issues, there exists a strong consensus on the issue of pollution and the importance of a clean water environment. Thus, the industry can only look to government for leadership when addressing those concerns.

The Aquaculture and Commercial Fisheries Branch is the provincial agency responsible for the shellfish industry, and the Ministry of Agriculture, Fisheries and Food is expected to take a lead role within government in representing the needs of the industry regarding such critical matters as fair and consistent regulation, resource stewardship, and environmental pollution.

But it is recognized that there may be competing interests even within MAFF, let alone the broader levels of government.

Regulatory Role

Testing

Standards exist regarding water quality, farming practices, processing methods, and product handling. Fair and consistent enforcement of these standards is essential, and must occur in all areas of shellfish farming and at all stages of the process through to market.

Environmental impacts of pollution problems, such as pulp effluent, sewage, boat effluent, and logging need to be documented and acted upon. The enforcement of regulations should be undertaken in a firm, but fair manner.

Land Use

Land use regulations should be enforced with positive action to ensure that the violating tenures are brought into diligent use. In the short term, more diligent use of Crown land already allocated to shellfish production can significantly increase the total amount of production.

In the interests of effective and comprehensive coastal management, the Provincial government needs to update and expand its jurisdiction over B.C.'s intertidal lands and the marine resources associated with them. Shellfish farming should be promoted and take precedence over the dwindling wild shellfish fisheries along our coast. This would place emphasis on the industry's sustainable, environmentally compatible nature and positive economic benefits (if it were not for aquaculture there would be no Pacific oyster or Manila clam fishery in B.C.). The opening of new ground for shellfish farming of all species would increase production, create new jobs, enhance wild stocks for recreational use, improve control over product movement, and strengthen the industry's position in global markets.

R & D and Technology Transfer

Communication with industry representatives to ensure that research initiatives are undertaken that could produce benefits for the growth and prosperity of the industry is essential.

Often, it is the case that new information and technology already exists. Knowledgeable extension staff, vigilant to the needs of the industry, are needed to bring forward information on new developments that can benefit the industry.

Given B.C.'s ideal environment for shellfish farming, accurate and timely introduction, adoption, and refinement of production and processing technologies could give our industry the edge it needs to be a world leader in oyster production and quality.

Business Viability

Success is defined differently at each level of the industry. At the farm level, much of the industry has evolved because of the attraction to a particular lifestyle, not the maximization of revenue. However, as the industry grew, others were attracted to the business opportunities. Their focus is on increasing efficiency and productivity with understood business objectives in mind. Though farming can be accomplished by a diverse number of independent producers, higher levels of cooperation should exist between farmers, and between farmers and processors. The industry is too fragile to cope with internal conflicts and competition. The real competition exists from competitors outside of British Columbia, not from within the B.C. industry.

Cooperation and even consolidation at the seed and marketing stages could produce some advantages over independent and uncoordinated action in regard to seed acquisition. Likewise, a more consolidated approach at the marketing stage could bring some of the benefits of being a price setter, rather than a price taker.

Farm Management

Production, harvesting, and processing methods for oysters are fairly well established and, when used appropriately, can be profitable. However, improved business management (record-keeping, inventory assessment, integrated management) and husbandry skills are needed to increase the profitability of many operations.

To take advantage of economies of scale at the existing size of the industry, processing and preparation of the product for market must be a relatively centralized process.

Growth

Products of the shellfish industry are provided fresh to the market on a consistent basis. Efficient market growth can occur by increased demand from easily-served markets and by developing new markets. While the industry believes that the existing markets will absorb more product, the limiting factor is one of supply.

Therefore, it is important to increase the production capability of the industry.

In addition to ensuring that land allocated to the production of shellfish is properly used for that purpose, the establishment of new, or expansion of existing B.C. shellfish hatcheries is a priority. Increased industry support of B.C. hatcheries and nurseries could lessen the sector's dependence on foreign seed supplies and encourage genetic improvement of broodstock for culture in B.C.

Currently, there is an overproduction of eyed oyster larvae from U.S. hatcheries. This means that any new or expanded Canadian hatcheries will have to compete in an already highly competitive larvae marketplace. A successful hatchery sector needs growers diligently applying intensive culture techniques on all leases, thus creating greater domestic demand and an opportunity to export B.C. seed stock.

Mechanization

Development and application of mechanized grow-out and harvesting technology, especially for off-bottom culture, is needed to increase efficiency and reduce operating costs.

Production Costs

Labour is a significant component of the production and processing costs, accounting for as much as 50% of operating capital requirements. Competitors in other countries experience significantly lower labour costs, giving them a distinct advantage, particularly where shipping costs are not a major factor.

Diversification

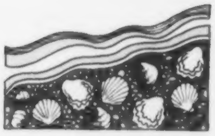
Expansion of oyster farmers into polyculture—culturing Manila clams on their beaches or Japanese scallops on their longlines—is perhaps the most expedient method of enhancing production capability, and will help defer the risks of rearing only one harvestable commodity. This increased flexibility in the marketplace is important for the viability of the shellfish industry.

However, because oyster seeding standards are conservative in regard to the numbers that can be seeded per unit of area, and clam seeding standards, on the other hand, are considered to be very high, there is a perception that existing regulations are creating problems for farmers wishing to enter into this form of polyculture. Flexibility in the application of regulations or policies governing new ventures is needed until husbandry practices have been better defined.

The culture of other types of oysters, such as the European flat oyster and the Kumomoto oyster, could provide access to valuable specialty markets for B.C. growers. Efforts to develop these products should, therefore, be encouraged.

Another area of diversification that would assist efforts to market B.C. oyster products is the production of sterile (triploid) oysters. Triploid oysters are preferable as a summer market product to replace the normal diploid oysters, which tend to become "spawny" and less appetizing during their reproductive season along certain sections of the coast. The triploid oysters do not reproduce, and remain firm and tasty during the warmer months. The availability of triploid oysters to B.C. growers could be increased through hatchery production of triploid larvae for remote setting at growers' sites.

Manila Clams: Industry Profile



Intertidal clams have a long, established history as a wild fishery, but represent a new commodity group in British Columbia's aquaculture industry.

The Manila or Japanese littleneck clam was accidentally introduced into B.C. waters by oyster farmers with shipments of oyster seed from Japan in the early 1900s. Adapting well to local conditions, Manila clams spread rapidly along British Columbia's south coast, forming the basis of a successful commercial fishery, especially during the last decade.

Since the early 1980s, a strong demand for fresh clams has grown rapidly in established world markets, with farm gate prices soaring from $0.32/kg in 1987 to $0.84/kg in 1990. A gold-rush attitude quickly developed among commercial harvesters. Digging activity increased sharply and peaked in 1988. When the inventory of market-size clams on traditional clam beaches became depleted, many clam fishermen chose to harvest in more remote areas and on beaches previously considered too difficult to harvest economically. It now appears that the Manila clam fishery may depend on the recruitment of individual strong year classes. This could lead to significant annual fluctuations in commercial production.

With the current levels of supply, the market demand for Manila clams is expected to remain strong. The potential for clam culture to maintain high, sustainable yields has captured the interest of many members of the shellfish industry. The growing desire to establish commercial clam farming in British Columbia has been reinforced by the successful application of clam culture methods in Washington State.

Oyster growers have shown strong interest in clam farming as a means of achieving product diversification and increasing utilization of their foreshore leases. The preferred species for culture is the Manila clam, although the experimental culturing of other species, such as geoducks, is a possibility in the future.

In recent years, three organizations professed to represent the interests of the Province's clam farmers: the B.C. Shellfish Growers Association, the Clam Farmers Association of B.C. and the Aquaculture Association of B.C. In

September 1991, farmers' efforts to rationalize differences resulted in agreement to unify the sector's representation, and the CFABC has been incorporated under the BCSGA.

Production Overview

The goal of any clam farming operation is to increase production from a given area of beach so that it is a more profitable venture. There are two basic operational strategies for achieving this goal:

- Seeding—
  This technique involves the planting of clam seed to ensure a minimum recruitment level, to replace or supplement variable natural spatfalls.
- Enhancement—
  This technique relies on natural recruitment (from both wild and farmed clams) to provide seeding for the beach.

Increased production can be obtained ideally by:

- covering the beach with net-like material to increase larval settlement and post-setting survival
- thinning of clam stock from higher intertidal beach or too densely populated areas and transplanting to other regions within the tenure so as to optimize growth
- practising planned, rotational digging.

Enhancement does not necessarily constitute culture in itself. Typical culture operations will apply both strategies, with primary emphasis on the regular seeding of tenured beaches. The production cycle for cultured Manila clams includes the following stages:

Hatchery

This stage involves the spawning of conditioned broodstock and rearing of larvae to the pediveliger stage, at which time they enter the metamorphosis phase. (Clams do not exhibit eyespot as do oyster larvae.) Larvae and/or juveniles are then transferred or sold to clam nurseries.

Hatchery production of larvae is capital and knowledge intensive. Limited technical information exists on Manila clam hatchery production and remote setting, since most of the current industry expertise is controlled by a few U.S. hatcheries. Recent experimental projects aimed at developing clam hatchery and nursery technology in B.C. has resulted in the successful production of over 200 million pediveliger larvae in 1991. Similarly, significant progress has been made with remote setting for Manilas.

Nursery

In this intermediate stage of culture, juvenile clams are reared to a size suitable for intertidal planting (5 mm to 12 mm).

Currently, one commercial clam nursery in B.C. and two Washington State nursery operations provide Manila seed to B.C. clam farmers for grow-out. An experimental study of nursery methods appropriate for the B.C. clam industry is in progress.

Grow-Out

This stage of culture involves seeding portions of the intertidal zones of selected beaches with clam seed, protecting those areas from predation, and allowing natural tidal flow to provide the requirements for growth to a harvestable size. Virtually all harvesting of cultured clams is done by hand and represents a very significant percentage of a farm's overall cost of production.

As of December, 1991, 65 licensed clam farm tenures were registered in the Province, with a further 11 applications pending. Many of these operations are also licenced oyster farms. This means approximately 240 ha of intertidal foreshore are currently available for Manila clam production in the Strait of Georgia and on the west coast of Vancouver Island.

Market Profile

The wild Manila clam fishery has grown steadily in volume over the last ten years, peaking in 1988. Table 7 shows the relative growth of Manila clam culture against wild harvest volumes and values.

All clams harvested in British Columbia must be taken to a federally registered shellfish processing plant where they are weighed, washed, and purged of sand. Virtually all B.C.-produced clams are sold fresh in-shell, with a very small volume being frozen prior to sale. No value-added product is presently being produced. Restaurants and seafood markets are the primary market, with little or no promotion/marketing effort being made by Canadian companies.

The largest volume of clams is sold to U.S. buyers, mainly along the eastern seaboard, throughout the west coast states, and in Hawaii. Domestic sales are mainly to Ontario and within B.C. Exports to Europe are on the decline since Italy has emerged as a major producer of Manila clams.

While demand for fresh "steamer" clams is expected to remain strong, prices for Manilas are already high ($1.86/kg to $2.05/kg retail) and are not expected to increase significantly. The industry must recognize that competition from product substitutes such as the New Zealand cockle, native littlenecks, and mahogany clams could price the Manila out of the market. However, Manilas are considered by many to be a superior product in terms of shelf life and consumer acceptance.

TABLE 7: Manila Clam Production in B.C.

	Wild Harvest		Aquaculture	
Year	Quantity (t)	Value ($)	Quantity (t)	Value ($)
1981	317	323,000	—	—
1982	597	611,000	—	—
1983	1 049	1,043,000	—	—
1984	1 677	1,813,000	—	—
1985	1 914	2,278,000	4	4,000
1986	1 894	2,762,000	7	14,000
1987	3 608	6,003,000	25	43,000
1988	3 833	7,023,000	30	59,000
1989	2 764	5,965,000	31	96,000
1990*	1 456	3,760,000	40	100,000

* estimated

In order to preserve consumer confidence, it is essential that product quality be maintained. The wholesome, natural image of clams and other related shellfish is the key to their current popularity in the marketplace. The next step is consistent supply. Today's world markets want quality products on a consistent, scheduled basis. The only way to achieve this is through farming.

Clam aquaculture in B.C. has attracted much attention in recent years for the following reasons:

- There is a substantial growth in demand for the product and a high market price.
- The potential exists to diversify the current shellfish farm production base.
- Approximately 1 500 ha of intertidal land, currently under tenure for oyster production, is viewed as prime clam production habitat.
- An estimated 4 000 ha of additional coastal beach area is considered ideally suitable for clam culture production.

- The potential exists to offset dwindling wild stocks through intensive farm management and enhancement techniques. Expanding shellfish culture along our coastal beaches will result in truly sustainable oyster and clam populations in neighbouring areas by virtue of natural recruitment from cultured stock. This positive side effect will benefit recreational and commercial harvests on non-tenured foreshore.

By the late 1990s, clam farming production could potentially reach more than 2 500 t annually, surpassing B.C.'s wild clam fishery. Development to date has been tentative, however, due primarily to:

- federal restrictions on harvesting cultured stocks on farm tenures
- policy restrictions, which limit access to suitable new sites and set unrealistically high minimum seeding requirements
- early stage of transfer of technical knowledge coupled with limited culture experience under local conditions
- limited capability for determining economic viability of clam farming.

General Economic Trends

Since the B.C. clam farming industry is in an early stage of development, many factors concerning production costs and economic trends have yet to become apparent. However, with the support of the clam fishery, shellfish farming community, and shellfish processing industry, clam farming in B.C. has the potential for rapid growth. Positive results from early culture trials clearly indicate that the industry has started in the right direction.

Critical Factors for the Success of Clam Farming

Clam farming is a new and growing industry and represents an opportunity for the shellfish industry to diversify the product base and increase output on existing leases.

Continued and successful development of British Columbia's clam industry largely depends on the following factors:

Securing Quality "Farmland"

A significant clam culture industry could evolve on land currently leased for oyster culture. A Letter of Understanding between the Federal and Provincial governments agreeing on areas of responsibilities with regard to the development and regulation of this industry has been recently signed. However, even though not all oyster leases are realizing their full production potential, additional leases are needed in some areas to facilitate the growth of clam farming. Without access to beaches that have been in the commercial fishery, clam culture will likely be limited to oyster tenures.

An improved set of biophysical criteria for site selection is needed as a first step toward profitable production of Manila clams. This step must be followed by the development of economic production plans based on site characteristics.

Government Regulation

Existing provincial policy dictates a very high density of clam seeding. Federal fisheries regulations do not allow for proper stock management through thinning and sale of excess small product to processors as is the practise with other commodity groups (e.g., pan-size salmon or cocktail oysters). These restrictions can result in slow or stunted growth, producing large numbers of undersized mature clams that cannot be marketed legally under current federal harvest-size regulations.

The current seeding policy and harvest-size regulations present an unnecessary obstacle for aquaculturists. Successful clam farming demands flexibility in regulations and their application.

Production

Husbandry practices for production of both seed and marketable clams have been developed in other countries, but not standardized or published for ready, low-risk application in B.C.

In order to ensure the long-term viability of its clam culture industry, B.C. must develop local sources of high-quality, inexpensive clam seed. More importantly, husbandry techniques for optimum growth and survival must be refined in order to achieve high profitability.

Poaching of clam stocks from farm tenures adds to production costs in terms of surveillance, product loss, and secondary damage to remaining stock.

Harvesting and Processing

Insufficient water quality monitoring capability for both PSP and fecal coliform severely restrict the development of clam farming. The federal government must be persuaded to establish more comprehensive monitoring programs. Depuration of shellstock from Schedule 1 closure areas could also increase clam harvest volumes; however, implementation of established depuration technology acceptable to regulatory agencies has developed slowly, with only two small facilities operating in B.C.

As clam culture production increases, the shift from manual digging to mechanical harvest systems must eventually be made in order to reduce production costs. Such mechanization should have the added benefit of minimizing damage to under-sized clams and the intertidal substrata.

Marketing

While the primary demand is for fresh live clams, value-added product lines that will fully utilize the resource and penetrate new markets should be developed. The decision to market any given product type, however, will depend on production costs, transportation methods, competitive pricing, and consumer demand. The identification of specific niches in the market place for products that are tailored to customers' individual needs is essential if lasting success is to be achieved.

Currently, B.C. cannot supply enough clams to meet market demands. Over digging has severely impacted the wild and recreational fisheries, despite new permit procedures.

The outlook for farmed clams, however, is promising. Not only is there an inherent consistency of supply to meet the demand of growing markets, but the very nature of the industry ensures natural spawn from farm stock that will continue to enhance adjacent beaches for recreational and wild harvest.

Scallops: Industry Profile

Until now, the wild scallop fishery in B.C. has been relatively small, with an annual production of about 70-80 t. Four species of native scallop—the weather-vane, *Patinopecten caurinus*; the rock, *Crassadoma gigantea*; the pink, *Chlamys rubida*; and the spiny scallop, *C. hastata*—are known for their present or potential value in the scallop industry. None of these species occur in sufficient abundance to support a large scallop fishery. The first two species occur in low densities, which support localized recreational fisheries. The latter two support the relatively new commercial fishery for a whole-scallop product. The degree to which commercial scallop fisheries will expand in British Columbia depends on local abundance of species, the economics of fishing methods (diving or dredging), and the extent of market demand for the scallop products (whole or adductor muscle).

The Japanese or Pacific scallop, *Patinopecten yessoensis*, has been introduced to B.C. from Japan for aquaculture development because of its favourable culture characteristics and market potential. Annual production of this scallop in Japan is over 310 000 t, valued at over $300 million. China is also emerging as a fast-growing producer of farmed scallops.

At present, scallop culture in B.C. is a mixture of rapidly advancing research and commercial development. Hatchery research and development has been an early priority due to the need for a reliable seed supply for the new industry. The federal/provincial scallop project at the Pacific Biological Station was instrumental in developing hatchery techniques for Japanese and rock scallops. The first commercial-scale research and development scallop hatchery was established at Qualicum in 1989 with the assistance of federal R&D funding. The Ministry of Agriculture, Fisheries and Food has supported studies aimed at evaluating Japanese field culture techniques for suitability in commercial application in B.C.

As a result of a provincial/industry mission to Japan in 1988, an agreement was reached securing additional scallop broodstock and reciprocal arrangements for preferred purchases of equipment. Technology exchanges have also occurred, and more are planned.

At present, there are four commercial grow-out sites in operation, with five more in the planning stage. Island Scallops Ltd.'s hatchery has the capacity to produce enough seed to supply nearly 40 farms. In addition, floating hatchery technology is under development by Espinosa Mariculture Ltd. on Vancouver Island's west coast.

Production Overview

The scallop production process begins with the conditioning and spawning of broodstock scallops at the hatchery. The larvae resulting from successful fertilization and development are raised to metamorphosis on a diet of cultured algae in hatchery tanks. The resulting juvenile scallops (0.3 mm) are reared in nursery tanks for 3 to 4 weeks to a size of 0.8 to 1.0 mm. They are then transferred to an ocean nursery where they are grown to 0.6 to 1.0 cm in length in spat bags. Following the nursery phase, the scallops can be grown out to commercial size at a farm site in net and/or ear-hanging culture, both of which are suspended from submerged longlines. In preliminary production, Island Scallops Ltd. has produced over 40 million juvenile scallops (0.3 mm) from the 5 billion larvae reared in its hatchery. Improved methods will increase this production capability substantially.

Cultured scallops to be sold in-shell will normally be harvested at 5 to 6 cm, after 8 to 12 months of grow-out. Shucked adductor muscle meat, the primary product for marketing, is obtained from scallops grown to about 10 cm over a period of about 18 months.

Over 100 ha of suitable growing area will be required by 1993 to meet production estimates. Initially, grow-out sites will likely be located in the regions of Baynes Sound-Qualicum Bay, Johnson Strait-Quadra Island, and Kyuquot-Esperanza-Tofino. Ongoing work will determine which sites are best suited for commercial scallop culture. Each scallop farm site is expected to produce about 500 000 mature scallops, or about 75 t annually.

Market Profile

Landings of pink and spiny scallops are relatively low and are not expected to increase significantly. Pacific scallops from B.C. farms will begin to enter North American markets in the winter of 1991-92.

International markets for scallops are well established and very competitive. The primary producers are Japan, Canada (Maritimes), the U.S., Iceland, China, and the E.E.C. World production of about 656 000 t is from both wild fisheries and aquaculture. There are perceived product preferences in the marketplace: primary premium product is the sea scallop; white meat is desired over dark; large meat size commands higher prices; and certain geographic sources are viewed as preferable.

General Economic Trends

Scallop farming in B.C. is in its very early stages of development. Consequently, many unknown factors with respect to production cost and general economic trends have yet to evolve.

Over the last three years, scallop aquaculture in B.C. has attracted considerable attention for the following reasons:

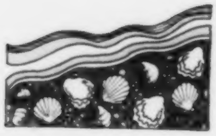
- There is substantial growth in the demand for scallops, and a high market price.
- The potential exists to diversify the current shellfish farm production base.
- The first large-scale scallop hatchery in North America was established at Qualicum.
- As grow-out is achieved by off-bottom culture, significant regions of the B.C. coast may prove suitable for scallop farming.
- The potential exists to augment wild scallop stocks as a natural result of intensive culturing techniques.

On the other hand, development has been gradual to date, due primarily to:

- early stage transfer of technical knowledge coupled with limited experience with culture under local conditions
- insufficient knowledge with respect to what constitutes ideal oceanographic site characteristics and the corresponding culture technique
- an evolving capability for determining the economic viability of scallop farming
- the fact that the sector has yet to complete a full production cycle.

With the support of the extensive infrastructures of the shellfish farming community and shellfish processing industry, however, scallop aquaculture has the potential for rapid growth. Positive results from early culture trials indicate the industry has a promising future in B.C.

Critical Factors for the Success of Scallop Farming



Continued and successful development of the Province's scallop farming industry largely depends on a number of critical factors.

Securing Quality Farm Sites

Studies on the grow-out of Pacific scallops in B.C. indicate that scallops have specific requirements for optimum survival and growth. These include a sheltered location with relatively high, stable salinity and cool water temperatures; abundant phytoplankton supply; low bio-fouling; and minimal potential for disease and parasites. Locating and securing biophysically suitable sites for grow-out will be an early limiting factor for the emergent scallop industry in B.C.

Marine scallop farms will require aquatic leases encompassing relatively large surface areas, and public perception of potential visual impacts may be negative. However, unlike other forms of aquaculture, virtually all production related equipment (floats and lines) are under water and only navigation markers remain visible to upland property owners and passing boaters.

Development of Production Practices

Husbandry practices and culture equipment from Japan have been introduced into B.C. However, further development work and technology transfer remains to be done if effective, economical methods for the grow-out of scallops are to be realized under local environmental and labour conditions.

Mechanized methods to harvest scallops from sub-surface longlines and efficient handling methods must be developed or introduced through extension of existing technology. Farmers must develop cost-effective open water harvesting techniques and must streamline the process of getting live product from the farm to the processing plant. Scallops have a short "shelf-life" out of water, which, unless observed and planned for, limits marketability. Development of oxygenated salt-water live-haul or holding systems could alleviate this problem.

Market Opportunity

Strong demand for scallops presently exists on a worldwide scale. Total international trade in scallops is worth nearly $1 billion U.S., based on worldwide harvests of roughly 656 000 t. Significant worldwide competition exists from Japanese, eastern Canadian, American, and Chinese production.

China has displaced Canada as the number one exporter of scallops to the U.S. However, Chinese growers (China has no wild scallop fishery) and processors are having difficulties with maintaining product quality.

Currently, demand for scallops greatly exceeds supply in U.S. markets. However, due to consumer preferences, there appears to be limited opportunity for successful generic marketing.

Most product is shucked (whether fresh or frozen), and all is marketed according to size and the presence of roe. European markets have a marked preference for "roe-on" scallops, while the U.S. market favours scallop meat.

Scallops are prized as a high-value seafood in most countries (especially Japan, Hong Kong, U.S., France, and Belgium, which consume the bulk of world production).

Financial Considerations

Since competition for markets will be intense, opportunities for B.C. farmers depend largely on the economic efficiency of the industry and on targeting a top-end premium quality product.

A pro forma financial assessment for the B.C. scallop industry is required, including production cost analysis, profit and loss statements, and return-on-investment studies. In order for such work to be meaningful, the industry must first complete its first complete crop production cycle.

Industry Infrastructure

The new scallop industry has a commercial-scale research and development hatchery, but lacks many other elements of infrastructure for a functional industry. In addition to the need for suitable sites, a sizable group of growers needs to be recruited into culture ventures to provide the labour, management, investment, and production capacity that forms the foundation of any industry.

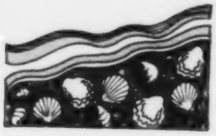
Processing facilities may be available through existing shellfish plants; however, additional development and investment may also be required for specialized equipment or new custom facilities.

Environmental Sustainability

Like other cultured shellfish species, scallops are susceptible to pollution from sewage and industrial effluent. Paralytic Shellfish Poisoning (PSP) from toxic algae blooms also affects the harvesting and marketability of the whole scallop product, though not of any adductor meat products.

The industry's efforts to make sound site selection decisions is hampered by a lack of long-term oceanographic data.

Outlook for Mussel Culture



Mussel production begins with the collection of natural seed, which readily attaches to (or "sets") on ropes suspended in B.C.'s coastal waters during the summer. Grow-out production of mussels is off-bottom, but predation from diving ducks in fall and winter forces culture to be done on rafts with predator nets hung around the perimeter to a depth of 10 to 15 meters. This added production cost is unique to the west coast, as east coast competitors can grow mussels on unprotected and less costly longline gear. This is not to say, however, that Maritime growers do not have their own production problems.

Mussel culture is also restricted to certain high growth-rate sites that allow much of the production to be harvested before predictable, substantial mortalities occur in the second growth season. Many regions along the British Columbia coast are affected by this die-off of farm stock just prior to marketing, critically affecting on-site production. Disease may be a component of this mortality. An additional phenomenon found on both Canadian coasts from time to time, is increased summer mortalities. The main cause is most likely elevated water temperatures during the summer months.

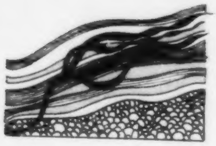
Recent evidence indicates that the B.C.-cultured blue mussel, an indigenous species, is probably *Mytilus trossulus*, not *M. edulis*, as previously thought (which is cultured successfully and abundantly worldwide). This may explain the different, and somewhat disappointing response of the B.C. mussel to culture.

Large volumes of mussels are produced in eastern Canada and the U.S. Consequently, there has been a levelling off of farm gate prices in recent years, and a very small profit margin has been realized by B.C. growers. Value added processing, which utilizes mussels harvested at a smaller size before summer die-off, may allow the industry to expand into new markets.

The cumulative effect of these and other factors has resulted in a decline in mussel production on the west coast. In 1988 there were five licensed growers, of which three farms reported production of 6.1 t worth $18,590. In 1990, only one farm reported any production.

B.C.'s mussel industry will likely experience slow growth, with few commercial operators, due to low market prices and high production costs. Hatchery production of *M. edulis* or *M. galiprovincialis* (Southern Bay mussel) could solve the biological problems associated with the premature mortalities of the indigenous blue mussels. Economic studies of the potential for these exotic species should be undertaken.

Outlook for Marine Plant Culture



The indigenous marine plant populations in British Columbia have long been recognized as a vast but essentially underutilized resource that could contribute significantly to the economy of coastal communities.

With the goal of deriving maximum economic and social benefit from the marine plant resources of B.C., both the utilization of wild stocks and the development of marine plant mariculture have been undertaken.

Of the 476 marine plant species that occur in the coastal waters of B.C., nori and sugar kelp are currently cultured commercially in the Province.

Marine plant farming in B.C. is at a relatively low level compared to other world producers, where seaweed products support a multi-billion-dollar industry. Because of its favourable geographic location and natural resources, B.C. has the potential to make a major contribution to the world's seaweed industry.

The farming of sugar kelp, *Laminaria saccharina*, requires a combination of laboratory culture and marine grow-out. Small strands of rope are placed in laboratory tank systems with the plants to allow the spores to set. Once the resulting sporophyte plants have reached a certain size, the ropes are removed and cut into small pieces. Each piece is placed between the braids of longlines, which are then deployed at a marine lease site. The resulting plants grow to marketable size in five months.

This kelp is harvested for kombu, which is used for seasoning and to make soup stock. The plants' broad blades are sun-dried on racks. It is important that they be dried quickly to ensure quality in appearance. A dark brown or greenish colour is preferred, and the blade should be thick and of uniform size. Kombu culture can only be expanded with increased markets.

Porphyra, a marine algae, is cultured, processed, and marketed in B.C. for the manufacture of nori. The culture of *Porphyra* also necessitates the laboratory collection of spores from adult plants to acquire stock for culture. Oyster shell is used as a setting substrate for the released spores. The spores attach to the shells and develop into the microscopic conchocelis stage. Several months later, the nets are placed near these shells to be colonized by spores released by the conchocelis. After one month, the nets are set out at a salt-water grow-out site.

Porphyra is susceptible to fungus and bacterial infections. Nursery culture of the species entails the exposure of the plants to the air for 3-4 hours per day to reduce the incidence of disease.

The algae is grown on nets positioned horizontally at or just below the surface of the water. The nets are harvested with a mower approximately every 10-14 days, and the freshly harvested nori is processed into sheets. Plant clippings are washed, chopped into a slurry, and poured onto drying screens. The slurry is then dried, bundled, and shipped to market. Nori is not a staple food commodity but provides minerals, vitamins, and flavour.

The best sites for nori culture are those that receive large quantities of sunlight and sufficient vertical mixing of waters to ensure a high level of nutrients in the top half-meter of ocean. In B.C., the populated Gulf Islands offer ideal sites. However, the Canadian Coast Guard has been reluctant to approve sites that may interfere with navigation.

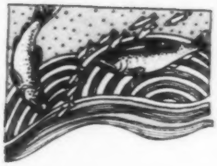
Because the industry is currently reliant on the importation of seeded nets from Japan, the risk of importing unwanted organisms or diseases exists. Should the industry increase in B.C., the production of seeded nets in B.C. may become a worthwhile venture and merits encouragement.

Despite much optimism among entrepreneurs in marine plant culture, seaweed cultivation is not without its downside. Under-capitalization has been a major impediment. Due to a lack of local industry expertise or proven profitability of marine plant enterprises, major financial institutions have been unwilling to lend money to farmers.

The outlook for nori culture in B.C. is for a moderately-sized industry serving domestic and U.S. markets by the end of this decade. Such growth would be contingent on growers gaining secure access to suitable sites in the lower Strait of Georgia. Cultured kombu is anticipated to remain a minor commodity due to limited market demand. In general, variable market demand is the current major limitation on marine plant culture in the Province.

Freshwater Aquaculture

Development Objectives for the Freshwater Aquaculture Industry



As with all aquaculture commodity sectors, the fundamental goal of participants in British Columbia's freshwater farming industry is sustainable business viability. Such success is directly linked to market opportunity, operational efficiency, and long-term profitability.

The industry grows and sells its food products in a complex and changing environment. Taking into account the sector's developmental history and operational potential, three primary objectives have been identified as necessary steps that must be addressed by both industry and government.

Objective 1: to increase the demand for B.C.-produced freshwater aquaculture products

- There is a need to properly identify trout and other freshwater products as to their place of origin (this would give consumers the opportunity to choose B.C. products first).
- There is a need for an industry-driven quality assurance program to enhance the image of B.C. products and increase public confidence in the quality and safety of the local products.
- The sector must take advantage of opportunities to increase market demand by introducing and promoting value-added products such as fillet, smoked, paté, stuffed portions, etc.
- Enhance consumer awareness by promoting the nutritional value of freshwater fish.

Objective 2: to reduce the cost of producing farmed freshwater fish in British Columbia

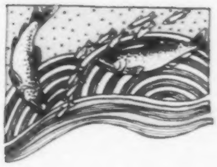
- The industry must take all reasonable steps necessary to reduce the cost of operations.
- The industry needs enhanced broodstock development programs, as well as access to other freshwater species, in order to facilitate operational diversification, differentiation of B.C. products, and increased market potential.
- Industry and government must work together to ensure publicly funded research and development efforts focus on the practical needs of the sector (specifically, projects aimed at enhancing production efficiencies and market competitiveness).
- An expansion of existing field extension services is needed in order to provide farmers with information on initiatives that can help reduce costs, improve processing practices, and assist development of value-added products.

Objective 3: to achieve the maximum benefit from government agencies having jurisdiction over the freshwater aquaculture industry

- In order to ensure that government is informed of industry's needs and fully recognizes the implications of policy and regulation on the sector, farmers must agree to a coordinated approach that results in one representative voice for the industry.

- Industry must lobby for government policy and regulations that: (1) more accurately reflect the agricultural nature of the business; and, (2) lead to the development and enforcement of rational guidelines to govern not only trout farmers, but all users of the waterway and any other interests which could have a negative impact on water quality and rights of access.

Freshwater Aquaculture: Industry Profile



British Columbia's first licence to commercially culture rainbow trout was issued in 1956. Since then, the number of licensed commercial trout farms has increased to 99 in 1991. Most commercial freshwater farms are small in scale and family run, having developed as ancillary operations to existing agricultural farms or other business ventures. Freshwater fish farms and hatcheries currently employ approximately 300 people.

The freshwater aquaculture industry consists primarily of hatcheries, commercial grow-out farms for processed trout products, and fee-fishing operations. Rainbow trout is produced for food market sales, fee-fishing, and stocking-out. Stocking-out includes sales of eggs and juvenile fish to other fish farms and private ponds.

Industry members are actively exploring methods to expand and develop markets and to improve the efficiency of existing operations. The bio-economic feasibility of rearing alternative species is also under exploration. Potential species for commercial freshwater culture in British Columbia include other trout species, Arctic char, Pacific and Atlantic salmon, white sturgeon, and the signal crayfish.

A few B.C. trout growers are presently rearing Arctic char for broodstock and some food market sales. The cultivation of char, however, is still in the early stages, and production technology is not well established. Although production is expected to increase, growth will be gradual due to the limited availability of broodstock. Another factor slowing development is Ministry of Environment, Lands and Parks policy of not authorizing the farming of char at any new sites.

The primary freshwater aquaculture organization in the Province is the British Columbia Trout Farmers Association (BCTFA). BCTFA is a producer-oriented group and is centralized in the Lower Fraser Valley. Although the BCTFA's membership represents only 15% of licensed operations, the Association accounts for over 80% of B.C.'s trout food market sales.

Production Overview

Rainbow trout is produced throughout British Columbia, with 45% of the trout producers located in the lower Fraser Valley. This region supplies up to 75% of the Province's total rainbow trout production. The Thompson-Okanagan Region, as the second largest producing area, supplies 15% of the total trout production. Of existing operations with freshwater aquaculture permits, 50% reported fish sales in 1990. Table 8 provides information on production volume and sales value of trout farming in B.C.

Although trout production and sales have not increased substantially from 1989 to 1990, the 35-year history of the industry has shown steady growth. A 3% to 5% increase in production value annually is significant when viewed over the long term. In 1990, 54 farms reported food market and fee-fishing sales. Total estimated 1991 rainbow trout sales, excluding live fish sales, is 125 t, valued at $700,000. Producers anticipate rainbow trout production and sales to increase annually by 3% to 4%.

TABLE 8: B.C. Trout Farming Production and Total Value

	Production (round weight tonnes)			
	1988	**1989****	**1990***	**1991***
Fee-Fishing	28	9	7	10
Food Market	113	86	104	115
TOTAL PRODUCTION	**141**	**95**	**111**	**125**
TOTAL VALUE	**$688 695**	**$466 000**	**$581 000**	**$700 000**

* estimated
** large drop in 1989 production suspected to be a result of a reporting anomaly
SOURCE: MAFF

Until now, the freshwater aquaculture industry has relied on the importation of seed stock. Since 1987, however, the importation of rainbow trout eggs has declined from 5 million to 23 000 in 1991. Similarly, Arctic char egg imports have gone from 5 000 in 1987 to 72 000 eggs in 1989 to 7 000 in 1991. Sources of char eggs are limited, and eggs will continue to be in short supply for the next three to four years.

Although Arctic char will be available for food market sale in 1991, char producers are primarily concerned with raising broodstock fish to enhance their own stocks and for future local egg and fry sales.

Market Profile

At present, the British Columbia freshwater aquaculture industry is not competitive in local or international markets. British Columbia's strongest competitor in the local trout market is Idaho, which grows and processes over 60% of all trout sold in B.C. and is the largest producer of trout products in the U.S. Idaho trout farmers have ready access to large amounts of 13°-15°C ground water, which enables them to rear fish at considerably lower costs than B.C. growers. In addition to a lower price, Idaho has built a reputation for providing a consistent supply of trout in a variety of product forms. Due to lower production levels and higher associated costs, B.C. trout producers cannot presently compete in the international market. Nevertheless, B.C. trout generally arrives at local markets fresher than the Idaho product, indicating good potential for import replacement.

B.C. trout farmers work independently of other producers and are generally responsible for all aspects of the farming operation, including processing and marketing. As a result, maintaining a consistent supply of high-quality product on a province-wide basis is often difficult. In addition, due to the small size of the average operation, producers are generally unable to explore product development options, or adequately promote and distribute their product. Freshwater aquaculturists need to identify common goals and coordinate their activities to address these issues.

Arctic char appears to have good market potential. Arctic char is native to northern Canada and has only recently been recognized for its potential in freshwater aquaculture. Like trout, char could be available fresh on a year-round basis, has superb eating characteristics, and commands a high market price. Arctic char carries a "fresh, clean" image that is projected by its name and Canadian source. Unlike markets for trout, the char market is unexplored and appears small due to limited product availability and the current low profile of the product. Yet the potential remains; char is virtually unknown in the American market, and export opportunities may exist.

To increase market share, considerable effort must be directed toward developing a market for the B.C. product. Ideally, char farmers will produce a 1 to 2 kilogram product (or larger) to avoid competition with lower-priced trout products in the marketplace. Market development relies on the education and increased awareness of consumers. The success of a marketing plan can be measured by the level of import replacement and increased sales of B.C. product.

British Columbia's primary market strength lies in its ability to produce a high-quality, fresh product, largely due to provincial water resources, which are cold and pristine. In addition, the B.C. product has a "safe," healthy image, and consumers appear willing to support local producers.

General Economic Trends

British Columbia is a net importer of farmed trout. Provincial producers supply only 40% of the local market for freshwater trout.

B.C. farmed trout is generally sold fresh, in the 225 to 350 gram range, dressed, head-on with bones in. In Ontario and British Columbia, the wholesale price for dressed rainbow trout ranged from $5.75/kg to $5.95/kg in mid-1991. By comparison, the wholesale price for Idaho trout, F.O.B. Vancouver, was $4.30/kg to $5.00/kg.

B.C.'s freshwater aquaculture industry is not presently involved in regulated marketing. However, industry members are currently exploring options related to industry structure and recognize the need to raise funds to drive an effective marketing initiative. At present, farmers have three options: maintain the status quo; establish an industry-wide levy with Bill 44 under the *Farming and Fishing Industries Development Act*; or develop a voluntary cooperative. The cooperative approach has proven to be successful for the Ontario and New Brunswick trout farming industries.

Arctic char production in British Columbia is limited. As a result, current sales are small and sporadic. However, the potential for business diversification appears promising. Farmed Arctic char portions from Ontario sell for up to $12.68/kg.

The freshwater aquaculture industry must be prepared to survive fluctuations in production costs and farm income. The first step toward stabilizing total net farm income is to effectively manage risk and organize business affairs (i.e., have business development, marketing, and production plans in place prior to entering the industry and revise these plans periodically).

Research and Development

The BCTFA has identified the following research and development priorities:

- marketing strategy
- definition and implementation of quality assurance standards
- value-added product development
- breeding programs, such as broodstock development, late-maturing trout, and sex-manipulation technology (triploidy)
- fish nutrition
- cause identification and treatment of strawberry disease
- technology transfer.

Critical Factors for the Success of Freshwater Farming

In order to improve its economic viability, the freshwater aquaculture industry must focus efforts in three major areas: increasing market opportunities for their products; realizing improved production efficiencies; and, securing better water rights to unpolluted aquatic resources.

Governments also have important roles: setting legislation and policy in consultation with industry; maintaining a reasonable regulatory environment; vigorous advocacy for the industry at various levels; and, providing responsive research, development and extension programs.

To effectively address these issues, industry and government need to clearly understand each other's position, what the inherent constraints may be and where potential opportunities lie. Cooperative effort is the key.

Product Market

The industry is faced with a clear marketing challenge. Trout producers from the United States, particularly from the State of Idaho, sell trout in British Columbia at a price that is below what local trout farmers currently need to cover production costs.

The development of a viable commercial freshwater aquaculture industry in B.C. depends on production growth coinciding with market development. Dealing with the latter, there are two major considerations for B.C. producers: (1) undertake marketing activities to increase the size of the total market, on the assumption that they will be able to fill at least a portion of the increased demand, and (2) undertake activities aimed at increasing the specific market share of the B.C. producers.

Analysis of marketing issues identifies the following factors:

Product

Idaho producers experience excellent conditions for raising trout and have become the major source of supply for the large U.S. market. Consequently, they have benefited from certain economies of scale and have a compact and efficient industry. Idaho product dominates the B.C. market.

Trout is usually sold as a whole fish (i.e., with the head and tail on). This may help perpetuate the notion that trout is a sport fish that one should catch, rather than buy.

The consumer appears to prefer easy-to-use product forms (e.g., fillets, smoked, prepared products). Farm product is capable of being processed and packaged in different forms, but most B.C. producers and processors are not meeting this demand. Value-added processing offers opportunities to increase demand for trout products at the retail level.

Current industry production in B.C. is largely an independent undertaking that is uncoordinated and of insufficient size to supply local marketplace demand should competitive products be displaced.

An industry that relies on one primary product is vulnerable to market supply-and-demand fluctuations. Diversification offers some protection to the producer and increases the size of the total market for freshwater fish products. Expansion opportunities also exist at all stages of fish culture, including egg sales, fish for stocking-out, fingerlings, and fry. Each can be produced in British Columbia in greater quantities than is now being realized.

Price

Price is an important factor, particularly when the consumer is not aware of the origin of or differences in the trout being offered.

Higher B.C. production costs, relative to Idaho costs, result in greater wholesale prices that are difficult to justify to consumers in the absence of promotional support.

Place

A significant portion of the demand for trout in British Columbia is from the restaurant trade. The next major market for trout is the many seafood retail outlets in the Province. At present, trout sold through the retail system is not identified as to source of origin. The consumer is not given the opportunity to chose between a B.C. product or an import.

Insufficient statistics on specific trout product sales through the various distribution channels in B.C. is a limitation to market strategy development.

Due to strong competition from U.S. producers (who, in addition to enjoying lower production costs, provide greater market support), it is unlikely that significant marketing opportunities exist over the next few years for B.C. trout beyond the Province's borders.

Promotion

Consumer awareness and education about the industry and its products is generally poor or totally lacking.

At present, the consumer is provided with little, if any, information about the quality and good taste of trout in general, and, more specifically, as to why a B.C.-grown product is potentially a better choice than an imported product.

Currently there is virtually no product differentiation in the marketplace as to place of origin. Product tagging for example, would enable the consumer, rather than the retailer or wholesaler, to make the ultimate choice between domestic or import product.

The industry in British Columbia is small and spread throughout the Province. While this does provide some benefits, such as good access to specific local markets, it is also an obstacle to marketing and distribution coordination among producers. Without an enhanced level of industry coordination, it will be very difficult to ensure a constant supply of fresh product into all markets.

Investment spending in the promotional area is required to secure a larger market share. The B.C. industry is not currently large enough to afford the cost of undertaking an aggressive marketing program.

Business Viability

To prosper, the industry must become as cost competitive as possible. While promotion and product differentiation will provide the market opportunity, cost is a major factor in determining profitability. As in any agri-business, it is important that aquaculture producers keep pace with changes in production methods and technology to keep production costs as low as possible.

At present, the majority of B.C. producers do not employ current culture technology and lack the necessary expertise to operate a facility at optimal efficiency for maximum yields at minimal costs. Many growers find it difficult to access the latest information on technical options and managerial opportunities.

The majority of B.C. trout farms are small-scale operations. New technology often means new financing, which can be difficult to obtain for a small business with limited resources.

Considerable product is lost to natural predators, most of which the farmer is restricted from taking action against. This is an issue that involves the provincial and federal governments.

Recent licensing requirements are considered a cost that could be reduced, or eliminated. Producers consider their domain that of agri-business rather than a segment of the fishing industry. Agriculture farmers do not have to pay license fees to farm their product.

For B.C. trout farmers fish disease is not a major problem. There has been virtually no demand for antibiotics and disease mortality rates are low. Though not a factor causing mortalities, strawberry disease is a cost of production and marketing issue, as labour intensive hand grading and culling are necessary.

Freshwater fish farmers, in general, are lacking improved fish stocks. To enhance diversification and competitiveness, development of broodstock and the opportunity to expand to additional species, including sale of disease-free eggs, is needed.

All activities undertaken with respect to species development must continue in a manner that does not permit the spread of any disease or unwanted organisms.

The Environment

Access to good quality water is essential for the sustainability of any aquaculture industry. When it comes to fresh water, trout farming is a non-consumptive industry. It is in a fish farmer's best interests to ensure that the integrity of the aquatic resource is maintained. However, that same grower often falls victim to pollution caused by other types of farming and land use.

Freshwater fish farmers lack adequate protection from upstream activities that can have a negative impact on water quality and quantity. Aquaculture companies are rarely informed of new upstream developments in the planning stage, limiting the grower's ability to effectively assess potential impacts and consider alternatives before definitive action is commenced. Although there is a referral mechanism to notify the aquaculturist of upstream activities—the process involves municipal government, the Department of Fisheries and Oceans and the B.C. Ministry of Environment, Lands and Parks—often the process does not work, to the detriment of the trout farmer. Overall coordinated management of inland waterways is lacking.

Public concerns with respect to the potential environmental impacts of freshwater aquaculture have also been expressed. It has been demonstrated, however, that aquaculture operations have minimal impact on the environment when properly sited and managed. Land-based trout farms draw water from a surface or ground water source and discharge water to land or an adjacent water body. Access to surface water, waste water quality, and the discharge location are monitored by the Ministry of Environment, Lands and Parks. When required, fish farm operators are responsible for employing acceptable waste management practices. In cases where waste water is discharged to land or where the receiving water body has low natural productivity, aquaculture may actually have a positive impact on the environment.

Aquaculture conducted in freshwater lakes has elicited considerable interest, due to its economical and biological advantages. Provincial lake aquaculture guidelines (to ensure that intensive aquaculture in lakes does not adversely affect the environment), have not been fully developed and implemented, however. The transfer of current waste management technology and water quality information to industry will also help ensure environmental sustainability.

Role of Government

Governments exercise significant influence over the business climate in which aquaculture enterprises must operate. The factors most important to freshwater farmers are:

Regulation

While it is natural to resist increased involvement and regulation by government, there is also a recognition that without government regulation there would be greater risks in the business environment. However, people do not want to be regulated more than is necessary, nor more than anybody else.

Trout farming differs significantly in profile from marine salmon aquaculture: trout culture is largely conducted on private property; the business profile, structure, and scale of operations are different; and, different factors impact growers. However, there is little differentiation between trout and salmon farming in government policy and regulation.

The parallels between aquaculture on private land and traditional livestock agriculture are obvious, yet the two industries exist in vastly different regulatory worlds.

Government Coordination and Consistency

Freshwater aquaculture occurs within federal, provincial and municipal jurisdictions. Competing and/or conflicting interests in regard to water use, or adjacent land use, can involve several jurisdictions—all with different priorities which often are not in the best interest of the fish farmer.

There are a considerable number of inconsistent and sometimes conflicting policies and objectives emanating from different government agencies within various levels of government. There are even cases of inconsistencies within departments or ministries regarding the interpretation and application of policy and regulation.

Research, Development and Extension

Industry benefits from access to research results and information regarding new developments or applications of technology relevant to culture operations and processing. This also applies to marketing information, including information on the development of value-added products and introduction of other species. In keeping with current trends, effective dissemination is best achieved through enhanced field extension services.

Over the course of a farm's business cycle, various government agencies request detailed information from trout farmers. Reliable data bases are necessary for industry trend analysis and projections. However, in some cases the requests appear to be either redundant or the data may be available from other sources. Often, there is little or no feedback after the information is collected and farmers are not provided survey or reporting results. The farmer wants to obtain value for the time he spends complying with information requests.